PROCEEDINGS

OF THE

ASSOCIATION OF OFFICIAL SEED ANALYSTS

OF

NORTH AMERICA

1940

IMPERIAL MYCOLOGICAL
28 JULY 1941
INSTITUTE

Thirty-Second Annual Meeting

Auburn, Alabama

June 18-21, 1940

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1939-1940

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REPORT OF THE EXECUTIVE BOARD

During the year 1939-40 the Executive Board, as provided for in the new constitution, decided on the place of the annual meeting which was made necessary by the cancellation of the meeting of the International Seed Testing Association in Washington, D. C. It was unanimously agreed that we should hold our meeting this year in Auburn, Alabama. The Board also approved publication of the Proceedings by the Sauls Planograph Company of Washington, D. C., for a sum considerably less than printing would have cost. Publication has been completed and copies will be available soon.

Your president and chairman of the Board has made an effort to keep the members of the Association informed of many matters of interest by short articles in the News Letter.

At the meeting of the Board on June 17 at Auburn, six of the ten members were present and Dr. C. W. Leggatt was represented by Mr. W. H. Wright. Several matters of importance were discussed and the Board submits the following recommendations:

(1) That there be an amendment to the by-laws so that the retiring president will serve as chairman of the program committee with the president, vice-president, and two other members of the Association.

(2) That the by-laws be amended to require that an abstract of papers be submitted to the program committee not less than 30 days prior to the annual meeting for approval for presentation, and to give the editorial committee discretion to reject papers for publication in the Proceedings.

(3) That the incoming president or someone designated by him represent the Association on the Seed Council of North America.

(4) That the proposed uniform State seed law be approved.

(5) That all copies of the Proceedings be made available for sale at $1.00 each. - W. A. Davidson, Secretary.

MINUTES

The thirty-second annual meeting of the Association of Official Seed Analysts was held in Auburn, Alabama on June 18-21, 1940. The following actions were taken at the meeting:

I. The proposed uniform state seed law as published by the Agricultural Marketing Service under date of June 12, 1940, was adopted with minor amendments. While the Association would not oppose the adoption of the proposed uniform law with required labeling to show the rate of noxious weed seeds per ounce, it urges that other associations approve what the Seed Analysts' Association believes to be preferred, that the seed be labeled to show the rate of occurrence of noxious weed seeds on the basis of the number per pound.

Section 1, E-1 and 2, were amended to read as follows:

"(1) Primary noxious weed seeds are the seeds of perennial weeds such as those that not only reproduce by seed, but also spread by underground roots or stems and which when established are highly destructive and difficult to control in this State by ordinary good cultural practices. Primary noxious weed seeds in this State are .....

"(2) Secondary noxious weed seeds are the seeds of such weeds as are very objectionable in fields, lawns, or gardens in this State, but can be controlled by good cultural practices. The secondary noxious weed seeds in this State are the seeds of....."

Section 2, A-5 was amended to read as follows:

"The name and approximate number per ounce of secondary noxious weed seeds when present singly or collectively in excess of (a) 1 seed or bulblet in each 5 grams of Agrostis sp., Poa sp., Rhodes grass, Bermuda grass, timothy, orchard grass, fescues except meadow fescue, alsike and white clover, carrot, reed canary grass, Dallis grass or mixtures of seeds included within this group; (b) One seed or bulblet in each 10 grams of ryegrass, meadow fescue; foxtail millet, alfalfa, red clover, sweet clover, lespedezas, smooth brome, crimson clover, Brassica spp., flax, Agropyron spp., and other seeds of similar size."

II. The Association tentatively adopted the tolerances contained in the Regulations under the Federal Seed Act. Final action cannot be taken on this until the next annual meeting.

III. A recommendation to the effect that certain proportions of hard seed of various kinds of the legumes be included within the percentages of hard seeds was referred to the incoming committee on rules and regulations for further consideration.

IV. The association adopted a tentative amendment to the definition of pure seed and inert matter which was also reffered to the committee on rules and regulations. The tentative amendment is to insert in the definitions of "Kind of seed under consideration" and "Inert matter" after the words "broken seeds", the words "and/or insect-damaged seeds" so the two definitions would read as follows:

"Kind of seed under consideration: This should include all seeds of the kind under consideration whether shriveled, cracked, or otherwise injured; Provided, (a) that in case of broken seeds and/or insect-damaged seeds, any piece larger than one-half should be included, while pieces that are one-half or less should be considered inert matter; and (b) that seeds of legumes and crucifers with the seed coats removed; should be considered inert matter.

"Inert matter: Broken seeds and/or insect-damaged seeds when one-half or less; seeds of legumes or crucifers with the seed coats removed; undeveloped and badly injured weed seeds which upon visual examination, are clearly incapable of

growth; dirt, stones, chaff, fungus bodies (such as ergot and other sclerotia and smut balls), and any other matter not seeds, should be considered inert matter: Provided, (a) That in the case of grasses, empty glumes should be considered inert and only glumes containing caryopses (grains) considered pure seed; (b) that attached sterile glumes of grasses should be considered inert matter and should be separated from the fertile glumes, but with some grasses (e.g., Rhodes grass), where the separation of the sterile glumes would involve an excessive amount of work, this procedure may be omitted, but the report should indicate such variation from the usual procedure; and (c) that the presence of fungus bodies, when present, should be recorded and reported.

V. The Association instructed the committee on rules and regulations to study the rules for seed testing laid down under the Federal Seed Act in order that the Association may decide whether the differences should be accepted and incorporated in the rules of the Association, or whether the Association should advise that changes be made in the Federal rule.

VI. The research committee was instructed to study the methods of testing the range grasses which have recently entered trade channels.

VII. The Association adopted the following recommendation made by the research committee:

"This Association does not seek to restrict in any way the research activities of individual analysts. Nevertheless, research problems assigned to definite subcommittees should be handled by them entirely in as far as the study of such problems as a definite association activity is concerned. Other subcommittees may be asked to cooperate, but only as members of the subcommittee to which the problem is assigned. Individual research workers studying problems similar or paralled to one assigned to a subcommittee ought, as a matter of good will, to provide the chairman of that subcommittee with an abstract of such study when it is to be presented at the same time as the subcommittee report. This will enable the chairman concerned properly to coordinate his report and will make for more worth while discussion of the points at issue."

VIII. The incoming president was directed to appoint a committee of three members of the research committee to confer with the United States Department of Agriculture for the purpose of effecting action toward uniformity of testing through referee work to be supervised by a representative of the United States Department of Agriculture.

IX. The following actions were taken with respect to membership in the Association:

Miss Mary E. Woodbridge was elected to honorary membership.

The Research Laboratory, which is under the direction of Dr. C. W. Leggatt, Ottawa, Canada, and the State Seed Laboratory, Tallahassee, Florida, were elected to membership in the Association.

X. Action was taken to have each member laboratory appoint a correspondent for the News Letter.

XI. The Association moved to amend the by-laws so that the retiring president will serve as chairman of the program committee, with the president, vice-president, and two other members of the Association.

XII. Action was taken to amend the by-laws to require that an abstract of papers be submitted to the program committee not less than thirty days prior to the annual meeting, for approval for presentation, and that the editorial committee have discretion to reject papers for publication in the proceedings.

XIII. The incoming president was directed to serve as a representative of the Association on the Seed Council of North America, or to appoint a person to serve in this capacity.

XIV. The Association took action to sell all copies of proceedings for $1.00 each.

XV. The Association voted to express its sincere appreciation to:

(a) The Alabama Department of Agriculture for making it possible to hold the meeting in this interesting section of the country.

(b) Dr. L. N. Duncan, President of the Alabama Polytechnic Institute and his associates, for the genial hospitality and cordial friendship.

(c) Mr. George H. Marsh, Department of Agriculture and Industries, Montgomery, Alabama; Mr. R. E. Lambert, Jr., President of the Southern Seedsmen's Association; Mr. J. L. Peppard, President of the Western Seedsmen's Association, representing the American Seed Trade Association; Mr. R. R. Childs, Secretary of the Georgia Crop Improvement Association; and Mr. R. A. Edwards, of the American Seed Trade Association; for their instructive remarks and expressions of cooperative spirit.

(d) The Tuskegee Institute for extending a cordial invitation to visit their campus.

XVI. The Association voted favorably upon a resolution to adopt a more emphatic and intensive educational program and a better seed campaign as follows: "The Association recommended and urge that each State Seed Laboratory contact the State Agricultural Extension Service and suggest that an intensive educational program for the production and distribution of better seed be undertaken and that the State Seed Laboratory give its support to such a program."

XVII. The Association elected Mr. F. A. McLaughlin, State Seed Analyst, Amherst, Massachusetts, to be vice-president; Mr. C. N. McIntyre automatically succeeds Dr. R. H. Porter as president of the Association, and Mr. W. A. Davidson was re-elected Secretary-treasurer.

XVIII. The chairmen of the standing committees were appointed by Pres. McIntyre as follows:

Research	-	Dr. R. H. Porter
Legislative	-	Mr. L. A. Moore
Rules & Regulations	-	Mr. W. O. Whitcomb
Membership	-	Mr. C. A. Stahl
Public Service	-	Mr. J. E. Casey
Editorial	-	Mr. M. T. Munn

W. A. Davidson, Sec.-Treas.

TREASURER'S REPORT

July 15, 1939 to June 1, 1940

Balance as of July 15, 1939		$1,497.97	
Receipts:			
Laboratory dues	$340.00		
Proceedings	130.00		
News Letter	4.00		
Rules for Seed Testing	8.56		
Miscellaneous	3.77		
Interest on savings account	10.88		
		$ 497.21	
			$1,995.18
Disbursements:			
Proceedings	$728.00		
News Letter	36.90		
Postage & stationery	64.36		
Bonding of treasurer	5.00		
Miscellaneous	24.12		
		$ 858.38	
Balance as of June 1, 1940		1,136.80	
			$1,995.18

As of June 1, 1940

Checking account	$492.78
Riverdale bank	380.59
Prince George bank	263.43
Total	1,136.80

W. A. Davidson
Secretary-Treasurer

Auditing Committee A. P. Kerr

J. W. Woodside

REPORT OF EDITORIAL COMMITTEE

The work of this committee, as outlined in the constitution is divided into 5 groups; The Proceedings, The News Letter, The Handbook, The History of the Association, and the Seed Bibliography. Although the work of the different groups is related, each group has conducted its work independently and each will make an individual report.

The proceedings have been edited jointly by the Chairman and by Mr. M. T. Munn, Bibliographer. Copies of the 1939 Proceedings are ready for distribution. The present volume of Proceedings is smaller than in recent years because much of the last annual meeting was given over to discussion of material for the Handbook, which material was turned over to the editor of the handbook.

Last year it was suggested than an index of the News Letter be prepared. Since Mr. W. O. Whitcomb has started preparation of such an index, it is recommended that the new Editorial Committee cooperate with Mr. Whitcomb in the completion and publication of an index to the News Letter.

The present editor, like his prececessors, urges that members use greater care in preparing papers for publication. It does not seem too much to ask that authors consult recent volumes and follow accepted procedure in preparing papers, especially in preparing tabular material and "Literature Cited". It is suggested that the Association give consideration to the publication in the Proceedings of briefer committee reports containing only material of permanent value. Provision could be made for the distribution in mimeographed form of more complete reports giving material of immediate interest to Association members. The cost of publication of the Proceedings is excessive in comparison with the possible income of the Association. - E. H. Toole, Chairman.

REPORT OF THE EDITOR OF THE NEWS LETTER

This report is short and to the point.

When I agreed to accept the editorship, I knew little or nothing about the duties entailed. The contacts made have been enjoyed and the contributions appreciated. From cooperation received I am tempted to ask - "Why a News Letter"?

From more than 100 members, sixteen contributed sixty-four articles or in other words approximately 14% of our members contribute. Of those contributing, Iowa led with 12 items, Illinois 9, Commercial 8, New York 7, Canada 5, U.S.D.A. 5, Alabama 4, Minnesota 3, Ohio 3, Connecticut 2, and the following members each contributed one item - Colorado, Arkansas, Nebraska, Indiana, Missouri, and Montana.

In the beginning I conceived the idea of a questionnaire, hoping for a good response. This response was negligible, therefore it is suggested that in the future each laboratory designate a correspondent and charge them with the responsibility of making contributions monthly.

If we are to remain an active organization we must keep the News Letter alive. For some laboratories it is the only contact they have with the Association and I feel that if we cannot maintain a good News Letter it either should be discontinued or reorganized to insure its continuation.

There were eight issues of the News Letter this year - the first being issued by Dr. Crosier of New York and the remainder by the present editor.

Total expenditure for the News Letter was $41.37 of which $23.49 was for postage and $17.88 for stationery supplies. - Joseph E. Barnes, Editor

REPORT OF HISTORY COMMITTEE

The history committee has continued collection and assembling of materials according to the plan and work of previous years.

It now appears that this work will be completed and materials be placed in the hands of the publications committee by January first. - Anna M. Lute, Chairman.

REPORT OF THE BIBLIOGRAPHER

The disturbed conditions of the world have been plainly reflected in the amount and type of literature dealing with seed study and investigation which have appeared as separate articles or as abstracts in abstracting journals of societies. Previous to several months ago the contributions from foreign sources were fairly regular but since that time there has been a decline. Just what effect this situation will have on the future is of course very uncertain.

Those who subscribed to the card index and abstracting service of the International Seed Testing Association received the yearly delivery of indices early in the year. Just what can be done in the future in the form of this international collaboration is at present exceedingly uncertain.

In North America reports dealing with the quality of seed stocks seemingly have kept apace with the times in many respects. There is a noticeable change from the more formal tabular type of report containing pages of data to the more modern form of illustrative material with short condensed tables or summaries. Some of these formal and sometimes questionable and uneconomical types of reports will no doubt continue until the statutes requiring such a report are changed. Some of these voluminous reports appear months after the seed samples were acquired and after any practical form of usefulness has passed.

In the field of pure research and seed technology there have appeared several noteworthy contributions. The effect of various seed treatments on seeds are being studied. More recently the effectiveness of hormones and vitamines on dry seeds and upon germination and seedlings is being made the subject of many investigations, and a few contributions upon this subject have appeared.

The bibliographer would like to inquire if it would be a service to the members if one or more pages giving titles and abstracts or a short resume of articles were periodically prepared for the News Letters, or do members have access to all articles as they appear. - M. T. Munn, Bibliographer.

REPORT OF THE LEGISLATIVE COMMITTEE

For many years there has been a general interest in uniform state seed laws. The enactment of the Federal Seed Act has greatly intensified that interest because in many state laws there are provisions that are incompatible with those of the Federal Seed Act.

Uniformity, within essential limits, in state seed laws will encourage the adoption of adequate enforcement policies in the states; it will promote cooperation between state enforcement agencies; it will promote the distribution of seed of more uniform and higher quality; it will tend to prevent the dumping of inferior or worthless seed in states when enforcement agencies are inadequate; it will lead to increased profits to farmers through the use of seed of better quality; it will simplify labeling problems now imposed upon the seed trade and will contribute to a more economical distribution of seeds.

Uniformity is earnestly desired but it will never be attained unless selfish motives are subordinated. The adoption of an agronomic attitude by both this association and the seed trade will tend to eliminate many of the situations which not only harass the seedsman but perplex the enforcement officer.

With this attitude the legislative committee began the task of preparing a uniform bill that might be recommended to the several states. The cooperation of the American Seed Trade Association and other interested agencies was sought and obtained to a very high degree. The legislative committee met with the legislative committee of the American Seed Trade Association and the committees on noxious weeds and uniform seed laws of the Seed Council of North America in Chicago on May 3rd and 4th. As a result of that meeting a proposed bill was prepared and with some minor changes in form and wording, it will now be presented for your consideration. You will recall that at the last annual meeting of the Association of State Directors, Secretaries and Commissioners of Agriculture a resolution urging the preparation of a uniform state seed law was adopted. Therefore, this Association is making its contribution to that end.

The bill may now be considered section by section. Discussion and criticism is invited.

Section 1, sets forth the definitions essential to the bill. In paragraph (3) noxious weed seeds are defined. It is desirable to recognize two classes of weeds as noxious but not of equal severity. Those weeds which seriously menace American Agriculture and when established do not yield to ordinary good farming practices such as field bindweed, Canada thistle, hoary cress and some others are considered primary noxious. They are made subject to more severe regulations than those such as buckhorn, dodder, mustard and some others which can be controlled by ordinary good farming practices. Provision is made for adding to or subtracting from the noxious weed seed lists but in many states that provision will be considered as a delegation of legislative authority, contrary to the State Constitution.

It is earnestly desired by your committee and the committee on noxious weeds of the Seed Council of North America, that the noxious weed seed lists be kept at a minimum. No one will dispute the danger of field bindweed in any region but to class ox-eye-daisy and buckhorn with it is not consistent with either sound agronomy nor practical botany. Further this committee, recommends that noxious weed seed lists be uniform within agricultural regions. That is, weeds that are noxious in Alabama should not be different from those in Georgia, Mississippi or Louisiana. On the same principle noxious weed seeds in Illinois should not differ from those of Iowa, Indiana and Ohio. To determine which weed should be listed in each region, we should look to our departments of agronomy rather than to our own laboratories. A seed analyst might like to class the foxtails as noxious because they are so often a nuisance but such an action would be without agronomic justification, yet some of the noxious weed seed lists contain weed seeds without justification from an agronomic standpoint. We ask that you give this classification of noxious weed seeds and the regional plan of designating them your thoughtful consideration.

Section 2 establishes labeling requirements for both agricultural and vegetable seeds.

Section 3 establishes prohibitions which seem reasonable but protective to the farmer.

Section 4 contains the customary exemptions. You will note that it does not exempt the farmer or producer. That is only fair. To exempt farmers or producers certainly defeats the intent of any seed law.

Section 5 defines the duties and the authority that should be conferred upon the enforcement officer and are believed to be essential to efficient administration.

Sections 6 and 7 provide for seizures and prosecution while sections 8, 9 and 10 provide for miscellaneous matter essential in most legislative practice.

There are many ways by which legislatures express legal enactments. There must be an enacting clause which this bill does not carry. For example in Illinois, immediately following the title the enacting clause is stated somewhat as follows: "Be it enacted by the People of the State of Illinois, represented in the General Assembly:" Then follows section 1.

Difference in legislative form among the states will probably prevent the acceptance of this bill as written but the essential principles are not contrary to any state constitution.

The committee will entertain any suggestion or criticisms of the proposed bill. We ask your cooperation. - L. A. Moore, Chairman.

REPORT OF THE MEMBERSHIP COMMITTEE

The constitution now provides for a membership committee which shall consist of not less than seven members and the duties are defined as that of receiving and making recommendations concerning applications for membership in the Association. The committee, also, has the privilege of submitting names for honorary membership for election at the annual meeting. The constitution defines the membership as Member Laboratories, Associate Members and Honary Members. With the approval of the president the following members were invited and consented to serve as associate members of the committee: L. N. Allen, Joseph E. Barnes, Miss Regina Schulte, A. Hope, Mrs. Bessie G. Sanborn, John L. Clough, and W. A. Price.

In as much as this is the first membership committee to serve the Association and therefore without precedent for guidance we were somewhat at a loss for working projects outside of what was outlined in the constitution. However, following the formation of the committee a notice was sent to the News Letter pointing out to all members that they have the privilege of making recommendations to the committee. This notice met with some favorable response and names were presented. Contact with the associate members of the committee during the year through neccessity was maintained by correspondence and the first meeting was not held until the members reached Auburn.

At this meeting all the accumulated business for the committee was given consideration and final decisions were reached. Your committee now presents for your consideration the research laboratory of Dr. C. W. Leggatt of Canada and the Florida laboratory as member laboratories and the name of Mary E. Woodbridge as an Honorary member. These names are very familiar to all the members of the Association and favorable action is recommended. - Chas. A. Stahl, Chairman.

REPORT OF THE PUBLIC SERVICE COMMITTEE

The report of the public service committee is a continuation of the work which was reported on by Chairman F.A. McLaughlin last year, namely the question of the Association sponsoring a National Seed Week. It was thought then that a study of the question should be continued and that perhaps a wider survey should be made to ascertain the opinion in various regions concerning the need and the propriety of such a Week. Accordingly, the committee made a fairly complete

study of the question and submits the following report for your consideration.

The replies to a list of questions brought forth the following pertinent information: (1) Educational agencies do not emphasize the value of good seed sufficiently. (2) Lack of educational programs; traditional carelessness; loose seed-law enforcement; too few seed growers; many farmers expect to buy from some one else rather than grow it themselves; poor farmers want to buy the cheapest seeds and not enough consideration given to quality; too much farmer-to-farmer trading on uncleaned untested seed; lack of funds, lack of knowledge; desire for financial returns regardless of consequences; lack of recognition of the advantage of good seed. (3) Shortage of funds for fundamental research and education; local growers not interested in producing seed that is needed; occasional drought periods; publicity to make farmers realize the folly of buying any but the bestseed; farm crops contaminated with weeds; not enough margin between common and certified seed to encourage wider distribution of pure seed; lack of recognition of advantage of good seed: (4) Standardize certification requirements and procedures; call attention to the use by many farmers of seed that should not be used; increased interest in better seed. (5) Frequent summaries of work done by seed analysts in a form that would attract attention of readers, doing away with the monotonous cut and dried way of reporting so many thousand samples received and tested for purity and so many for germination.

The survey showed a clear preponderance of opinion in favor of a national seed week (or month), that the opinion as to having one week (or month) for the whole country or for the country by regions is about equally divided, that the time for such a week (or month) is the month of March, that there are numerous important questions, problems, and topics that could very well be discussed during such a week (or month), and that the usual means of communication--newspapers, magazines, reports, exhibits, discussions, and radio--would be available for reaching the farming population with such information as an inter-agency committee might deem of sufficient interest and importance. The question of calling such a period by the name of "National Seed Week" is one that brought out a diversity of opinion. All agree that there is a distinct need for calling attention of the public to the matter of using better and improved seeds, but it is the opinion of a great many people that naming another "Week" would not command the attention that might be expected, especially from those whose attention is most greatly needed. A variation in the nomenclature, such as "National Seed Month", "Know-Your-Seed-Week", or "National-Know-Your-Seed-Month" might be well worth the consideration of the Association. - J. E. Casey, Chairman.

REPORT OF THE RESEARCH COMMITTEE

The work of the research committee has been continued on much the same basis as during the previous year. The reports of the regional chairmen are herewith presented in numerical order. Following them are the reports of the subcommittees arranged in alphabetical order together with their recommendations to the Association.

Report for Region No. 1

N. G. Lewis, Chairman

Ten laboratories in region No. 1 took an active part in the referee program. Two were unable to do so.

With a change of chairman a late start was made and only four referees on requested subjects were sent out. Mr. L. O. Whitcomb's program of pure seed and inert matter analyses was continued. Returns arrived somewhat late due to the fact that several laboratories were very busy. An earlier start is suggested for next year.

In a discussion held in December with Mr. Whitcomb, it was decided that interpretation of the results of referees should be on a broad basis or, in other words, not described in mathematical terminology alone. Unfortunately, where differences occur, one has to submit them to a test for significance if any discussion of results is to be reported. As a consequence, the new chairman had to learn several methods now applied to seed testing. This was worthwhile exercise attributable to the referee program. In general, however, as Mr. Whitcomb pointed out last year, the value of the program to individual analysts lies in doing the work and the interest is found in comparing one's results with those of other laboratories.

Individual reports on the four referees or referred samples are as follows:

Referee No. 1 - Chalcid Injured Red Clover: The object of this referee was to test the value of Method "D" described below. This method has been suggested as an official method of determining pure seed and inert material in chalcid injured seed. The suggestion was later withdrawn.

Methods followed:

A. Separate by hand all infested seed.

B. Separate by hand only seed with broken seed coats leaving seeds with seed coat intact in the pure seed fraction.

C. Use blower to make as complete a separation as it can be adjusted to make.

For pure seed 2.5 gram samples were analyzed in duplicate. For germination test the pure seed was tested 4 x 100 B.B. and the inert material from the 5 grams was bulked together for test on one blotter.

Results: Methods "A" and "C" give similar results. Germination results from Method "B" are highly variable due to the high proportion of inert material left in the pure seed. This was removed to the inert fraction in the other methods. It would appear that Method "B" is unsatisfactory.

The pure seed fraction contained approximately 1521 seeds. The inert material fraction 266 seeds per 2.5 gram sample. Inert material germinated in Methods "A" and "C", therefore represented approximately 532 seeds.

The number of normal seedlings germinating from the inert matter tested show no correlation with other variables within methods but as would be expected, there were fewer in Method "B".

Several laboratories differed significantly in germination and purity results. The resulting laboratories agreed closely, especially in Methods "A" and "C".

The value of the blower method lies in its speed. It was suggested that a final check by eye does not detract from this value materially. Apparently, a mechanical separation of this type of inert matter may be made promptly with considerable accuracy.

Referee No. 2 - Brome Grass: Referee No. 2 was a sample of light weight brome seed supplied by J. L. Schreiber of Northrup, King & Company.

Results: The number of normal seedlings in inert matter is very low, and no particular correlation is indicated.

Analysis shows a significant difference between blotter and soil tests and between some laboratories in germination results. (Laboratory #3 results received later.)

Laboratories are in very close agreement on pure seed percentages reported.

Method "A" - (Regular Method) Chalcid Injured Red Clover

Lab. No.	Germ-ination	Weak sprouts	Dead seeds	Hard seeds	Germ. & hard	Pure seed	Pure living seed	Normal seedlings in inert matter
	%	%	%	%	%	%	%	%
1	85.25	5.25	3.25	6.25	91.50	82.39	75.39	12
2	83.50	5.75	3.00	7.75	91.25	85.34	77.92	0
3	86.50	3.50	2.25	7.75	94.25	86.80	81.80	10
4	80.00	7.75	5.00	7.25	87.25	86.51	75.47	12
5	90.00	0.50	2.00	7.50	97.50	85.20	83.07	55
6	86.25	2.50	4.50	6.75	93.00	87.45	81.38	28
7	82.50	3.00	6.00	8.50	91.00	87.40	79.53	1
8	83.75	3.50	5.00	7.75	91.50	58.80	81.25	8
9	86.63	1.75	3.00	8.63	95.26	88.74	84.57	20
10	84.13	4.75	4.75	6.37	90.50	89.72	81.20	2
11	79.75	4.50	9.75	6.00	85.75	86.22	73.91	14
Average	84.39	3.89	4.40	7.32	91.71	86.78	79.59	15
Method "B" - (Remove only Seeds with Broken Seed Coats to Inert Fraction)								
1	68.25	5.25	20.00	6.50	74.75	95.00	71.01	9
2	73.75	3.25	17.00	6.00	79.75	95.98	76.58	2
3	76.00	2.75	14.25	7.00	83.00	94.25	78.23	31
4	62.25	8.75	22.50	6.50	68.75	96.23	66.21	0
5	61.25	2.00	30.75	6.00	67.25	96.13	64.70	4
6	70.75	2.75	21.50	5.00	75.75	97.88	74.14	3
7	68.00	2.50	23.25	6.25	74.25	96.10	71.40	2
8	66.75	5.25	22.00	6.00	72.75	97.05	70.60	0
9	77.12	1.37	12.63	8.88	86.00	95.46	82.09	1
10	73.25	4.38	16.37	6.00	79.25	97.10	76.71	1
11	68.00	6.00	20.00	6.00	74.00	96.76	71.60	0
Average	69.58	4.02	20.02	6.38	75.96	96.17	73.02	5
Method "C" - (Blower Only)								
1	81.75	6.50	5.25	6.50	88.25	82.32	72.65	33
2	87.75	2.50	2.50	7.25	95.00	86.22	81.69	25
3	86.25	3.50	2.00	8.25	94.50	74.00	69.93	26
4	81.00	6.50	4.00	8.50	89.50	87.75	77.63	31
5	x	x	x	x	x	x	x	x
6	85.25	3.25	5.25	6.25	91.50	85.69	78.41	58
7	86.50	1.50	2.75	9.25	95.75	84.00	80.43	2
8	82.75	5.75	3.75	7.75	90.50	87.79	79.45	51
9	88.25	1.75	1.00	9.00	97.25	88.20	85.77	56
10	82.50	4.38	5.37	7.75	90.25	87.88	79.21	4
11	86.00	3.25	2.50	8.25	94.25	83.47	78.88	78
Average	84.80	3.89	3.44	7.87	92.67	84.72	78.41	38

Summary of Results of Tests. Referee No. 2 Brome Grass

Lab. No.	Pure seed (1)	Inert matter	Germination of Pure Seed (3)						Germination of inert matter (2)			
			Blotters				Soil or sand		Blotters		Sand or soil	
			Strong	Weak, broken	Dead seeds	Hard seeds	Strong	Weak, broken	Strong	Weak, broken	Strong	Weak, broken
	%	%	%	%			%	%	%	%	%	%
1	93.5	6.5	82	2	11	5	80	1	0	0	0	0
2	92.4	7.6	86	1	13	-	84	0	8	9	0	0
3	92.4	7.6	82	2	17	-	86	-	9	1	0	0
4	92.5	7.4	78	5	17	-	76	5	0	0	4	0
5	91.5	8.4 #	83	1	16	-	82	1	3(4)	1	4	0
6	93.7	6.3	76	5	19	-	69	1	0	15	0	10
7	93.0	7.0	82	1	17	-	76	0	2	2	2	0
8	93.5	6.5	81	1	18	-	81	0	0	0	0	0
9	92.4	7.6	78	2	20	-	70	1	0	5	0	0
10	-	-	-	-	-	-	-	-	-	-	-	-

(1) Pure seed and inert matter determined on duplicate 10 gram portions.
(2) Number of sprouts from the inert matter from 10 grams of original seed.
(3) Germination, the average of tests 4 x 100.
(4) Used paper towels.

Referee No. 3 - Wheat: Referee No. 3 was a sample of wheat from the Montana laboratory. It was of light weight and contained many cracked seeds or pieces.

Summary of Results of Tests. Referee No. 3. Wheat

Lab. No.	Pure seed (1)	Inert matter	Germination of Pure Seed (3)					Germination of inert matter (2)			
			Blotters			Soil or sand		Blotters		Sand or soil	
			Strong	Weak, broken	Dead seeds	Strong	Weak, broken	Strong	Weak, broken	Strong	Weak, broken
	%	%	%	%		%	%	%	%	%	%
1	92.4	7.6	92	5	3	95	2	11	-	11	-
2	94.3	5.7	88	4	8	89	4	20	9	31	17
3	91.8	8.2	91	6	3	90	6	47	24	43	39
4	94.7	5.3	86	8	6	84	4	7	-	10	-
5	93.3	6.7	88	3	9	90	2	5	3	3	-
6	98.3	1.7	81	7	12	81	7	12	-	5	-
7	90.8	9.2	90	6	4	93	3	45	39	42	38
8	95.3	4.7	92	2	6	88	3	19	5	16	2
9	93.9	6.1	95	2	3	81	8	44	2	-	7
10	93.0	7.0	89	7	4	89	4	50	20	47	22

(1) Pure seed and inert matter determined on duplicate 50 gram portions.
(2) Number of sprouts from the inert matter from 10 grams of original seed.
(3) Germination, the average of tests 4 x 100.

Results: Results show considerable variation and indicate perhaps that the estimate of broken grains as inert material varies with different analysts.

The inverse correlation between pure seed and normal seedlings in the inert material fraction can be seen only in a broad way. The same is true of the direct corellation to be expected between results from some laboratories in germination and pure seed values.

Discussion: Owing to the fact that quite small pieces of wheat may produce normal seedlings, field tests only might show the real value of this sample. Some variability in our results might be attributed to exercise of judgment in applying the less-than-half-seed criterion in making the pure seed determination. As a check on the uniformity of samples sent out laboratories were sent samples from an "A" and a "B" mix. The figures show no differences attributable to these sources.

Referee No. 4 - Analysis of Weevil Infested Peas (Summary only): It would appear that the determination of the extent of weevil damage in peas is a matter for germination testing for the manner of weevil infestation is such, that the plumule and radicle may be undamaged and the cotyledons only partly damaged by the grub. According to H. Fabre, "Social Life in the Insect World", the eggs are laid upon the developing seed and the grubs penetrate the testa when they are about 1/25th of an inch long, leaving a hole or brown mark which may be seen under the binocular. Several grubs may penetrate the seed but only the one which gets to the centre first grows into a weevil. The others die, presumable for lack of essential food substance found at the centre of the seed. Observation leads to the further conclusion that not all of those which reach the centre survive to kill the seed, even though a considerable part of the cotyledons may be eaten.

Methods: In referee No. 4 a preliminary examination of the problem was made using a sample of Austrian Brown field peas sent by Mrs. Louisa Kanipe, Corvallis, Oregon.

Separation of the sample into infested and not infested seed was made by use of binoculars on the basis of 100 seed samples. The fractions were germinated separately and after the counts had been made, the cotyledons were examined for weevil damage.

Summary of results: Complete results are not tabulated, as some laboratories made a large number of tests and others made tests on 100 seed lots only.

Representative figures showed that 45% of the sample was infested or had been penetrated by weevil grubs and 55% was not infested or penetrated by weevil grubs.

Of the infested seeds 34% produced normal seedlings despite damage by grubs to the cotyledons.

Of the non-infested seed, 95% produced normal seedlings.

The average sample germinated 67.77% of which 15.44% could be attributed to the weevil damaged fraction and 52.33% to the undamaged fraction.

Separations made under binoculars were made with an error, varying from 0 to 9% as shown by subsequent examination of cotyledons.

Sampling error on the basis of 100 seeds would appear rather high in a sample of this kind.

Comments: Analysts' comments summed up to the effect that a germination test was essential. Mr. C. Tapp at Vancouver conducted many tests to show that their practice of treating such samples as a matter for germination testing only was a correct one.

Miss Dwight Forsythe at Pullman, Washington, mentioned the difficulty occasioned when such samples, and especially vetch, are sent to the laboratory for purity only. Apparently, cases arise in which the person would not understand why it was necessary to spend time and money for a germination test. (Incidentally, it had been planned to examine vetch as well as peas but a suitable sample was not forthcoming.)

Miss M. L. Spracher of Northrup, King & Company, suggested that the extent of

damage should be judged by germination test with a note accompanying the purity report as to the presence of infection and an estimate of the amount.

Mr. L. J. LaPine, Albert Dickinson Company, mentioned that "we feel this is largely a matter for germination testing except in cases where the weevil has emerged, leaving merely a shell".

Report for Region No. 2

R. H. Porter, Chairman

For the fourth consecutive year all (11) of the official laboratories in region No. 2 cooperated in the referee tests. In addition, 8 commercial laboratories participated. Studies were confined entirely to sweet clover seed in an effort to measure the emergence of normal seedlings in sand as a substratum and to compare such results with those obtained by blotter tests.

In December, 1939 a midwestern seedsman called the attention of the regional chairman to germination test results on five lots of sweet clover seed by two commercial and two official laboratories. Some of the lots were said to be among the best obtainable, hence his concern as to the extreme differences reported. The results obtained by the four laboratories in November 1939 are shown in Table 1, from which it may be noted that the extremes are great except for sample No. 5 and even there the difference in extremes is 15.5%.

Table 1. - Summary of tests made on five samples of sweet clover by four laboratories* in November, 1939.

Sample No.	1		2		3		4		5	
	Germ.	Hard	Germ.	Hard	Germ.	Hard	Germ.	Hard	Germ.	Hard
Laboratory	%	%	%	%	%	%	%	%	%	%
1	75	3	69	2	71	12	82	4	74	14
2	86	3	83	4	80.5	8.5	87.5	5	75	19
3	94	2	96	1	86.0	11.	94	3	84	13
4	81	2.5	80	2	79	11.	92.5	2	68.5	19
Mean	84		82		79.1		89.0		75.4	

*Laboratories 1 and 3 are official, Nos. 2 and 4 are commercial.

Samples of the five lots of sweet clover seed in question were obtained and 24 small subsamples were drawn from each bulk sample. Twenty-four laboratories were then supplied with one subsample from each of the five lots and requested to analyze same for purity and to test each for germination between blotters and also in sand. Upon completion of their tests the analysts were requested to return the balance of the pure seed fractions to the chairman. Nineteen laboratories made the blotter tests but only 10 were able to make the sand tests.

The summarized data, as reported by each laboratory, are given in Table 2. In the last 3 columns of the table are given the data as obtained by the Iowa laboratory with the 19 pure seed remnants of each lot that were returned to the chairman. These latter data are recorded as uniform tests because they were all made under the same conditions. It should be pointed out, however, that in the uniform germination tests only 200 seeds each were tested in blotters and in sand, whereas each laboratory used 400 in the referee tests.

Table 2. - Summary of Comparative Tests With Five Sweet Clover Seed Samples Submitted to 19 Laboratories and Compared with Uniform Test in Iowa.

	Pure seed	Germination		Sprouts in sand		Uniform tests in Iowa laboratory		
		Normal	Hard	Total	Normal	Blotters	Sand	Hard
	%	%	%	%	%	%	%	%
Lot No. 1								
Mean	99.7	81.7	3.6	86.8	78.5	85.0	84.3	2.9
Diff. in extremes		17		12	28	10	9	
Lot No. 2								
Mean	99.0	77.3	3.2	83.9	75.2	81.9	78.4	2.9
Diff. in extremes		17		13	11	8	7	
Lot No. 3								
Mean	99.8	71.7	12.2	76.8	69.0	78.5	73.6	11.5
Diff. in extremes		21		14	18	8	12	
Lot No. 4								
Mean	99.9	85.5	4.1	88.1	81.6	89.4	86.7	3.2
Diff. in extremes		15		12	20	6	7	
Lot No. 5								
Mean	99.8	73.6	16.3	76.2	69.6	77.0	73.8	17.0
Diff. in extremes		18		7	21	7	6	

It is evident that no difficulty was encountered in the purity analyses because in all cases the purity was 99% or above. A study of the data shows that for every lot the differences in normal sprouts are far greater than should be expected, the smallest difference in extremes being 15 and the greatest 21. Statistical analyses gave a probability far below .01 for each set of data obtained from blotter test by the 19 laboratories. In the sand the total emergence data gave much less variation but attempts to classify the emerged seedlings as to normality resulted in extreme variation. The counts for hard seeds were reasonably uniform for two out of the five lots in that probabilities of .20 and .45 were found for samples Nos. 1 and 3 respectively. The probabilities for samples Nos. 2, 4 and 5 were, .04 for No. 2, and less than .01 each for samples Nos. 4 and 5. Such results are somewhat disturbing in that there is no difficulty involved in making counts for hard seeds. It is possible that some environmental factor operated to affect seed impermeability.

A study of the data summarized in the last 3 column in Table 2 show that the pure seed fractions were highly uniform. Calculation of Chi-square and probability values gave the latter well above .05 for all of the samples, the average being over 50%. In studying these results it must be remembered that only 200 seeds were used from each fraction for the uniform tests, hence differences in extremes cannot be compared directly with those in which 400 seeds were used. Agreement between blotter and sand tests is fairly good for all samples except No. 3 in which case the mean number of normal sprouts in sand is significantly less than between blotters. Sand tests have proven themselves more reliable in the Iowa laboratory than have blotter tests.

Further examination of the data showed that about 5 laboratories could be placed in a group that obtained higher values for normal sprouts than the average of all. For further comparison the results obtained by three Federal laboratories included in the group were segregated and tabulated in Table 3. A third less well-

defined group obtained the lowest results and others were neither uniformly high nor low. The reason for segregating the federal laboratories is that if uniformity exists at all it should exist among those cooperating laboratories.

Table 3. - Tabulations for Three Federal Laboratories

Laboratory	Sample	Pure seed	Germination			
			In blotters		In sand	
			Normal seedlings	Hard seeds	Emergence	Normal seedlings
		%	%	%	%	%
Indiana	R-3709	99.8	82.5	3.0	80.0	77.0
Missouri		99.9	82.5	2.5	86.8	79.2
U.S.D.A.		99.7	81.0	3.5	88.5	84.8
Mean		99.8	82.5	3.0	85.1	80.3
P		O.K.	O.K.	O.K.	.01	.02
	R-3710					
Indiana		99.8	75.8	4.7	80.2	77.0
Missouri		99.8	71.8	4.5	83.0	72.8
U.S.D.A.		99.4	71.5	4.8	79.2	69.5
Mean		99.7	73.0	4.7	80.8	73.1
P		O.K.	.30	O.K.	.40	.06
	R-3711					
Indiana		99.9	65.8	14.5	69.3	65.3
Missouri		99.9	67.8	12.0	77.2	70.8
U.S.D.A.		99.9	68.8	11.7	76.0	67.2
Mean		99.9	67.5	12.7	74.2	67.8
P		O.K.	O.K.	O.K.	.02	O.K.
	R-3712					
Indiana		99.9	87.5	4.5	81.3	79.3
Missouri		99.9	79.5	6.0	85.0	81.5
U.S.D.A.		99.9	83.5	4.7	87.0	82.5
Mean		99.9	83.5	5.1	84.4	81.1
P		O.K.	.01	O.K.	.06	O.K.
	R-3713					
Indiana		99.9	73.7	16.0	71.8	70.3
Missouri		99.8	73.2	17.5	75.2	72.2
U.S.D.A.		99.7	72.0	17.0	74.5	70.5
Mean		99.8	73.0	16.8	73.8	71.0
P		O.K.	O.K.	O.K.	O.K.	O.K.

The data in Table 3 show reasonable uniformities for blotter tests with four out of five samples. In sample No. 4 the differences are far too great. In sand the differences in total emergence are too great for Nos. 1 and 3, and they are rather high for No. 4. For normal seedlings in sand the differences are too great for No. 1 and quite high for No. 2. There is good agreement, however, in the means for normal in sand and blotters. In one case the differences between normal in sand and blotters is extreme for sample No. 4.

In Table 4, the data obtained by the five laboratories showing fairly uniformly high results are given for blotters. Only three of the five made sand tests, hence those data were not included. The agreement in Table 4 is very good for 3 our of 5

samples. For sample No. 2 the differences are too extreme (four of the five were uniform) and for sample No. 4 the probability is just under 5%. It is odd that for sample No. 3 the numbers of hard seeds found is too variable. It may be said that the data for the five laboratories are nearly as uniform as those in Table 3.

Table 4. - Tabulations of germinations in blotters for three state and two commercial laboratories.

Sample No.	1		2		3		4		5	
	Germ.	Hard	Germ.	Hard	Germ.	Hard	Germ.	Hard	Germ.	Hard
Laboratory	%	%	%	%	%	%	%	%	%	%
Northrup-King	88.8	3.0	85.3	2.3	79.8	13.0	89.8	5.7	77.0	18.5
Mangelsdorf	86.3	4.5	83.2	3.7	74.5	15.2	89.0	3.8	75.2	18.0
Mich.	86.5	2.5	82.0	1.8	76.8	14.0	91.2	4.3	76.0	18.0
Wis.	85.2	5.0	74.5	5.0	74.7	8.5	87.8	3.7	76.7	13.0
Iowa	88.5	2.0	82.8	2.7	75.8	9.8	84.2	5.5	72.0	17.7
Mean	87.1	3.4	81.6	3.1	76.3	12.1	88.4	4.6	75.4	17.0
P	.50	O.K.	.01	.08	.85	.02	.04	O.K.	.48	O.K.

Table 5. - Comparison of Means of Germination Test Results from five Laboratories with three Federal Laboratories using Blotters as Substratum.

Sample No.	1	2	3	4	5
5 Laboratories	87.1	81.6	76.3	88.4	75.4
3 Federal Labs.	82.5	73.0	67.5	83.5	73.0
P	.01	.01	.01	.01	.25

In Table 5 is shown a comparison of the means for the results as given in Tables 3 and 4. The differences between the two groups of laboratories is highly significant except for sample No. 5. In making these comparisons it should be borne in mind that 2000 seeds were involved in each sample for the 5 laboratories and 1200 seeds for the 3 federal laboratories. It is evident that a fairly high degree of uniformity exists among certain groups of laboratories but one group is uniformly higher than the other or vice versa.

The conclusion which it seems justifiable to draw from this study is that differences in germination as obtained by different laboratories with high purity lots of sweet clover seed are not caused by non-uniform pure seed fractions but by differences in interpretation as to what is a normal sprout. The chairman offers the thought that the emphasis which is being placed on the differentiation of certain sweet clover seedlings as to normality or abnormality is disproportionate to its practical importance and that to achieve uniformity in seed testing a common basis of classification is necessary. Emergence in sand seems to offer the possibility of such a basis from which to begin in developing more uniform interpretation of results.

Support for the above suggestion is that the mean percentage normal in sand in the uniform tests was always slightly lower than emergence yet this mean for normal is close to the mean in blotters as obtained by the 19 analysts working independently. We may assume that when 19 analysts disagree so thoroughly on normal seedlings in blotters, some reading high and others low, the mean will probably represent the real value somewhat closely. Since this figure for all samples is reasonably close to the mean for normal in the uniform sand tests it

seems logical to assume that the figure for each of the 19 pure seed fractions in the uniform sand tests closely represents its value and furthermore there is uniformity in the results.

Report for Region No. 3

C. W. Leggatt, Chairman

The referee work undertaken in region No. 3 consisted of a single, extensive series of tests on 40 small samples of alfalfa for germination test. Cooperating laboratories were asked to test 2 x 100 from each sample between blotters, reporting Normals, Abnormals and Hard and 2 x 100 in soil or sand reporting Normals only. In addition to members of region 3 the same series was distributed to the remainder of the Canadian laboratories and to two or three outside laboratories who were interested. In all 25 sets of samples were distributed and it is very gratifying to be able to state that reports on this considerable project were received from 17 stations. The results for station No. 17 were received too late, unfortunately, to be included in the discussions which follow.

Preparation of Samples. - It may be stated now that all samples were drawn from a single lot of seed. About 5 lbs. of seed, having a rather high percentage of hard seeds, was thoroughly mixed in a Boerner grain sampler and then divided down repeatedly until 1024 samples of approximately 21.25 grams each were obtained. The division was done by a new type of sampler in which a falling stream of seed is repeatedly divided and remixed by a series of dividers and baffles.

Table 1. - Summarized Results of Referee Work for Region No. 3.

Station	Normal - Blotters		Hard Seeds - Blotters		Abnormal - Blotters		Normal - Sand	
	%	P	%	P	%	P	%	P
1	45.4	.47	38.6	.22	11.0	.02	47.9	.08
2	42.7	.41	41.2	.93	11.3	.85	44.6	.67
3	42.5	.67	41.0	.74	10.8	.50	43.5	.14
4	42.3	.43	41.6	.49	11.6	.47	39.7	.08
5	40.9	.40	41.8	.51	9.5	.84	47.4	.31
6	40.6	.06	44.2	.26	15.3	.24	38.9	.19
7	40.4	.80	39.9	.50	15.1	.63	38.4	<.01
8	38.9	.25	41.4	.41	15.0	.19	37.5	.52
9	47.8	.58	38.1	.26	8.2	.46	46.9	.16
10[X]	51.0	.22#	41.4	.32#	4.6	.94#		
11	42.9	.92	44.0	.04	9.6	.31	45.6	.09
12	44.7	.65	44.9	.88	6.3	.19	45.8	.30
13	43.9	.88	41.2	.17	6.8	.75	45.1	.96
14	42.3	.46#	43.7	.07#	14.0	.06#	41.8	.45#
15	47.4	.32	37.8	<.01	9.8	<.01	46.2	.08
16[X]	50.9	.82	34.4	.35	10.3	.15	51.6	.11
17[XX]	70.8	.81	21.3	.03	4.9	.37	73.2	.47
All Mean	43.8						44.1	
Stations X^2	> 157						> 388	
P	→ 0		→ 0		→ 0		→ 0	

X^2 test for homogeneity.
x Commercial Laboratory.
xx Results for station 17 were received too late for inclusion in the foregoing discussion. They are included, however, in the tables presented. It will be noted that the hard seeds are much lower in percentage than in the case of any of the other stations. This station was unable to start the work until a month or more later than the other laboratories, and it is possible that the time factor may be a contributory cause in this connection.

Results: Table 1 presents a general summary of the results. The first 8 stations are Canadian. The rest are United States laboratories, including the two commercial laboratories, Nos. 10 and 16, and are arranged roughly in order of distance from Ottawa. The P-values are calculated for goodness of fit between observed and expected results, the latter being calculated from the binomial distribution for the mean of the station in question. Two exceptions to this method of calculation are to be noted, namely stations 10 and 14 which did not submit sufficient results for this procedure, the chi-square tests in these cases being simply for homogeneity.

Hard Seeds: Since on a priori grounds, least variation is to be expected for hard seeds in which interpretation and germination methods should not be factors for variability, we may examine these first. However, we find that they do vary and that, from 34.4% to 44.9%, a highly significant difference based, as it is, on tests of 8000 seeds.

It was first noticed that two of the most distant stations shewed the lowest percentage of hard seeds. Hamly (1) a few years ago discovered that bouncing seeds of sweet clover overcame the hard seed condition without scarification. In the present connection it was first thought that the shaking to which the samples had been subjected en route had brought about this effect. As further reports came in, however, it was seen that this was not necessarily the case since some other distant stations reported high hard seed content and nearby stations reported low content of hard seeds. Hard seeds of alfalfa do become permeable very readily and it is suggested that the bouncing treatment they received in mixing and sampling, coupled with unfavourable conditions in certain cases in transit may have resulted in a softening of the seed coats. That this has happened in an uneven manner in one case is suggested by the results of station 15 in which $P < .01$. Analysis of variance indicates a somewhat higher variability between means of samples than within samples for this station, although the difference is not significant, while summation of chi-squares for the replicates of individual samples gives a value of $P = .08$. This indicates that the variability within samples, which is under the control of the laboratory, was almost on the border line of excess.

Looking at station 11 which has a value for P of only .04, examination of the detailed results (Table III)* shews that this low value of P is ascribable to some measure of irregularity within the observed distribution, since there were too many cases shewing exactly 40 hard seeds and too many shewing 49. If we group the classes in pairs, e.g: 37 or less, 38 and 39, 40 and 41, etc., and compare the observed with the expected results we get a value for P of .61, shewing that while there is some irregularity in detail, on the whole good concordance has been obtained with expectation. A precisely similar treatment of the results for station 15, however, brings about no improvement and P remains $< .01$.

The remainder of the results shew excellent concordance with expectation.

Normal Sprouts: Turning to normal sprouts, there is excessive variation between stations here also, but that it is associated to some extent with differences in hard seeds is shewn by the significant correlation - .58 (Level of significance; $r = .57$, $P = .02$) between normal and hard. Within stations, the uniformity is highly satisfactory as regards consistency of interpretation but there are differences in level of interpretation which we may not discuss.

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(1) Hamly, Douglas H. Softening of the Seeds of Melilotus alba. Bot. Gaz. XCIII, 4, June 1932.

* This table and others will appear in the News Letter where they may be studied.

The most obvious case is station 10 which is in apparent agreement with station 16. (These two are both commercial stations). However, it will be noted that station 10 has the normal number of hard seeds while station 16 has not, for reasons as already outlined, and station 10 has far fewer abnormal sprouts than other stations. It would appear that station 10 is counting about 7% more liberally than other stations.

Stations 12 and 13 also have lower than average abnormals and higher than average normals indicating a slightly more liberal interpretation than other stations.

At the other extreme is station 8 with higher than average abnormals and lower than average normals. It would appear that this station is somewhat severe in its interpretation.

Abnormal Sprouts: With regard to abnormals, most stations are fairly consistent in their interpretation although station 1 shews excessive variability. Where interpretation of normal sprouts is consistent, as in this case, and of abnormals is not, it seem reasonable to suppose that the border line of doubtful cases is not between normals and abnormals but between the latter and dead. Thus the variation between the laboratories in their interpretation of abnormals is not a serious matter.

So far we have discussed results of B B tests for individual stations. We may now consider some of these results taken collectively.

The mean percentage normal sprouts for all stations is 43.8. Chi-square is > 157 and $P \rightarrow 0$. Now, we have observed that there has occurred softening of hard seeds in certain cases and that obvious differences in interpretation have occurred. If we exclude such stations, we might be justified in making some such division line as follows:

Reason	Stations excluded
Interpretation normals and abnormals	No. 10
Hard seeds $<$ 39%	Nos. 1, 9, 15 and 16
Hard seeds $>$ 44%	Nos. 6 and 12

This leaves a group of 9 stations in which no "obvious" causes of discrepancy exist. For these stations, chi-square becomes 21.441 and P = .55. Thus this group at least has received uniform samples and is working highly uniformly. Within this group a tolerance based on P = .05 would in fact include 95% of the tests. The same tolerance, however, applied to all stations would include a far smaller proportion of tests on account of the greater spread of the range.

Tolerances previously published (2) were based on a value of P = .025, the difference between this value and .05 being a guess as to the probable amount of additional tolerance required on just this account. If this estimate was accurate, then a tolerance based on it would include 95% of the tests as would a tolerance based on P = .05 include 95% of the tests for a uniform group such as the 9 stations above, since 95% of the standard at which we were aiming. In a series of results, 95% would be comprised within a range of $\pm$ 1.96 x S.D. This product, then represents the range within which the desired proportion of results would be expected to fall. The object of the proposed formula was to devise a measure of this range. It was based, in effect, upon the theoretical value of σ and P = .025. P = .025 corresponds with 2.25 σ. Thus we should find 1.96 x S.D. nearly equal to 2.25 σ if the estimate is close.

This comparison has been made for all stations with the results which follow:

$$\text{S.D.} = 6.13 \qquad 1.96 \times \text{S.D.} = 12.0$$
$$\sigma = 4.96 \qquad 2.25 \times \sigma = 11.2$$

$$\text{Ratio } \frac{1.96 \times \text{S.D.}}{2.25 \times \sigma} = 1.07$$

The nearer the ratio approaches 1, the closer is the estimate in question.

Similar comparisons have been made (3) for red clover and timothy for the work of Canadian stations. The ratio for red clover was 1.08 and for timothy 1.25. The values for red clover and alfalfa may be considered very satisfactory but if timothy tests were always as variable as the figure 1.25 would indicate, considerably wider tolerances would be required to retain the same standards of certainty.

Soil or Sand Tests: The sand tests were disappointing. Chi-square for all stations was > 388, much greater than that for normal sprouts B.B. There exists a high degree of correlation between normals in blotters and sand which may either reflect differences inherent in the lots sent to the different stations or else the fact that judgment of one series of tests was influenced by the results obtained on the series first counted. Individual stations shew on the whole a lower level of consistency, with lower P-values, than in the case of blotter tests, while one station, No. 7, appears to have definitely failed in technique with $P < .01$.

A sand or soil test properly carried out should practically obviate the necessity of personal judgment since, except for watery sprouts or those with both cotyledons broken off, abnormal sprouts do not penetrate the surface. The two classes of watery and broken just mentioned should afford practically no difficulty in recognition, thus there should exist little, if any, interpretational error. Accordingly we ought to have as high a level of consistency as for blotter tests and, indeed, if the sand or soil tests are to be used as a guide for the interpretation of blotter tests, which is their chief function, we would expect the level of consistency to be higher.

Earlier in this discussion it was stated that in the case of station 15, excessive variability of the results might be related to differential softening of hard seeds due to mixing treatment and possible effects on the journey. If such effect had brought about a real difference between the samples, we would expect a positive correlation between the normals for blotters and sand for this station. However, the correlation turn out to be only +.10 while the levels of significance for 40 pairs of results are: for $P = .05$, $r = .31$; for $P = .01$ $r = .41$. Thus we must conclude that the very small correlation that does exist is not significant and that the tests do not shew any real difference between the samples sent to this station.

Conclusions and Discussion: This series of referee tests has demonstrated several things:

(1) In the first place it has shewn clearly the need for more referee tests of the same kind. There is still excessive discrepancy between the results of different stations and within the results of certain stations.

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(2) Leggatt, C. W. II, The X^2 test as a basis for computing germination tolerances. Proc. Int. Seed Testing Assn. No. 1, 1935 38-48.

(3) Leggatt, C. W. VIII. Studies on the distribution of germination tests. Proc. Int. Seed Testing Assn. No. 3, 1939, 140-150.

(2) It has indicated that conditions of sampling, packing and shipment may result in changing the condition of the seed between the time it is in bulk and the time it is tested for germination. Such a possibility should be carefully considered in sending out other referee or comparison tests.

(3) There is a good concordance between normals in blotters and soil or sand for means of stations, a highly significant correlation of +.81 having been obtained. This would indicate either that stations had carefully studied their sand tests before interpreting blotter tests, thus using the sand test as it is intended to be used, as a guide for interpreting normal sprouts, or else that such unity of judgment had already been achieved. It also reflects a real difference in the samples as received by the different stations.

(4) Certain stations will appear to be having difficulty with their sand tests or else, having made them satisfactorily have not sufficient confidence in them to let them do the job of distinguishing between normals and abnormals. It has been pointed out that watery sprouts and sprouts without cotyledons must be expected from those which the sand test will distinguish since both these classes of abnormals will emerge normally through the sand. They are generally readily distinguishable, however, and should cause little confusion. It is suggested that those laboratories which find themselves differing widely from the rest without apparent cause (e.g. different hard seed content) recast their views on the interpretation of sprouts.

(5) Stations with low values of P in any category might do well to review their methods and interpretations since this is an indication of erratic interpretation. This may be in one of two directions. There appears to be a tendency on the part of some to interpret a test in the light of preceding counts on its replicates. This tends to make the results more uniform than would be expected from a random distribution and its effect is to perpetuate any error of judgment which may occur in the first one or two counts; an effect which is inclined to exaggerate differences between laboratories. This is what has occured, mostly in a very mild degree, in the case of sand tests made by stations 3, 4, 9, 11, 16 but in none of these cases has it resulted in a significant departure from expectation. The other direction is towards too great variability in the results and this is what has occured in the other cases, several of them differing significantly or highly significantly from expectation. This is an indication of failure to hold clearly in mind a consistent border-line between normals and abnormals.

It would appear to this referee that a proper approach to this problem is, first, to carry a clear mental picture of the borderline between normal and abnormal sprouts based on careful comparison of blotter and sand (or soil) tests at frequent intervals during the seed testing year and then to judge each individual test purely on its own merits and without mental reference to replicates which have been counted before. In cases where several sprouts of highly doubtful nature occur, it seems permissible to "split the difference" counting half as normal and half as abnormal.

(6) Even in spite of the differences which we have been discussing, tolerances, based on a value of P = .025 such as those to which reference has been made, give a satisfactory standard of comparison for the work of different laboratories and result in a degree of certainty of approximately 95%. Similar tolerances, but based on P = .05, should be used for the comparison results within any one laboratory.

Report for Region No. 4
Bess Cowley, Chairman

This was one of the sub-committees which became somewhat disorganized as a result of change of leadership. The region had been asked to undertake referee tests for the association as a whole but was unable to get any work organized during the past year.

Report for Region No. 5
C. M. Bass, Chairman

Region No. 5 is composed of the same group of southeastern states as has been given in several previous reports.

There has been a marked increase in the number of analysts who participated this year. Twelve official and twelve commercial laboratories tested and reported on one or more of the samples sent out. This is the largest number of laboratories which has ever engaged in regional referee testing in region No. 5.

No reports were received from two of the principal official laboratories in the region.

Ottawa, New York State, and California State-Federal laboratories are members of other regions, but cooperated with us in testing a number of samples. Their support was very helpful.

Before the year's work was begun, letters were written to all official laboratories in the region to ascertain their wishes as to the kind of seed or problem they wanted to work with. It was then learned through the chairman of the research committee that there were a number of commercial analysts in various regions who were interested in taking a part in referee testing in this region also. Similar letters were written them. An effort was made at the same time to find out who could assist by supplying seed.

Eight samples were sent out during the year. Seed for these were furnished by participants, and each represented a problem of common interest.

Sample No. 1, Timothy, was selected because of its apparent weakness in germination. It contained a large number of weak, abnormal seedlings which made interpretation of its crop value difficult. These conditions are borne out in Table 1.

Table 1. - Summarized Statement of Results of the Germination of a Sample of Timothy reported by 22 Laboratories.

	Blotter Tests		Soil Tests
	Strong sprouts	Weak sprouts	Strong sprouts
Sample No. 1	%	%	%
Mean	65	16	67
Highest reported	83	32	89
Lowest reported	45	2	51

Sample No. 2, Lespedeza stipulacea, did not develop as we hoped it would. It had a high hard seed content early in the season, which quickly germinated after a brief rest period. Obviously, this change took place before these comparative tests could be made. This behavior is not unusual for lespedeza. Hence, its value as a referee sample is not as important as anticipated. It is interesting, however, to note the fairly uniform results, as shown in Table 2.

Table 2. - Summarized Statement of Results of the Germination of a Sample of Korean lespedeza reported by 18 Laboratories.

	Blotter tests			Soil tests
	Strong sprouts	Weak sprouts	Hard seeds	Strong sprouts
Sample No. 2	%	%	%	%
Mean	85	2	5	86
Highest reported	93	7	12	89
Lowest reported	75	0	2	83

Sample No. 3, Melilotus spp., was chosen because of the large number of weak seedlings, broken sprouts, and hard seed it contained. The presence of these were calculated to perplex the analysts in interpreting germination percentages. Obviously, laboratories who reported the higher germination percentages on this lot included in their counts a greater percentage of the weak and broken seedlings. This often occurs when counting off sweet clover; particularly if it has aged. See Table 3.

Table 3. - Summarized Statement of Results of the Germination of a Sample of Sweet Clover Reported by 21 Laboratories

	Blotter tests				Soil tests
	Strong sprouts	Weak sprouts	Broken Sprouts	Hard seed	Strong sprouts
Sample No. 3	%	%	%	%	%
Mean	72	8	7	8	68
Highest reported	83	19	15	12	80
Lowest reported	63	1	2	4	54

The purpose of samples Nos. 4 and 5, Beets, was to try out a revised method which had been suggested to eliminate the troublesome pre-soaking factor. Some analysts have been successful in germinating beets by the rolled rag-doll method without pre-wetting. It was suggested that a comparison of the rolled method and the method under the rules might prove to be an interesting referee problem. Details of these tests are given in Table 4.

Table 4. - Summarized Statement of Results of the Germination of a Sample of Two Samples of Beets Submitted to 11 Laboratories to compare the Official Method with the Suggested Paper-Roll Method

	Official method		Rolled method	
	Average percent of glomerules sprouted	Average number sprouts per 100 glomerules	Average percent of glomerules sprouted	Average number sprouts per 100 glomerules
Sample No. 4				
Mean	85	158	84	168
Highest reported	94	180	95	182
Lowest reported	79	117	60	152
Sample No. 5				
Mean	73	125	68	138
Highest reported	80	167	78	156
Lowest reported	64	100	54	125

Notes: "For various reasons tests in rolls were not entirely satisfactory".
"Official method has advantages which should not be abandoned".
"Rolled method developed less damping-off than in official method".

Sample No. 6, Andropogon sorghum, was said to have a germination range of from 61% to 83% and contained approximately 25 Johnson grass seed per pound. On the basis of reports received (Table 5), the germination range has been narrowed

Table 5. - Summarized Statement of Results Reported by 17 Laboratories on a Sample of Sudan Grass, No. 6

	Pure seed	Inert matter	Weed seeds*	Other crop seed	Germination	Duration test, days
	%	%	%	%	%	%
Mean	97.27	1.75	*	.93	80	10
Highest reported	98.75	3.35		1.43	85	12
Lowest reported	95.22	.33		.02	72	8

*Six of the 17 laboratories found Johnson grass seed present at rates of occurrence varying from 1 to 4 such seeds per 25 grams of working sample analyzed.

considerably. The reported presence of Johnson grass seeds in the samples varied considerably in the reports received. Only 6 out of 16 laboratories reported its presence. No doubt a number of re-checks will be made when copies of this table are forwarded to those who reported no Johnson grass seed found.

Table 6. - Summary of Reports by Laboratories on Samples Nos. 7 and 8 - Lima Beans

Laboratory	Sample No. 7				Sample No. 8			
	Germination %	Weak seedlings %	Bald heads %	Decayed %	Germination %	Weak seedlings %	Bald heads %	Decayed %
Official laboratories								
Ottawa(1)	-- 36	-- 18	-- -	-- 46	-- 31	-- 18	- -	-- 45
Virginia(2)	30 12	13 7	3 5	54	49 16	16 3	1 1	34
U.S.D.A.(3)	24 40	24 8	5	52				34
New York(4)	25 13	12	13	50	37 14	12	6	45
Cal. Fed-State	34	18	1	48	54	22		24
Commercial laboratories								
Z (5)	65 61	22 9	3	13 27	69 62	19 17	2	12 21
CC (6)	38 66	14		48	59 72	14		27
Mean	36 38	17 10	6 4	44 36	54 39	16 13	3 -	29 33
High	65 66	24 18	13 5	54 46	69 72	22 18	6 -	45 45
Low	24 12	12 7	1 3	13 27	37 14	12 3	1 -	12 21

Note: Percentages underlined were obtained by sand, soil, greenhouse, or field tests.

(1) Sterile sand used. Seed dusted with a 20% ceresan-talc mixture. Original test without ceresan was so moldy and decayed that a count was not possible.
(2) One hundred seeds of each of the two samples were planted in the field under conditions favorable to their growth. All seedlings were spaded up on the sixteenth day and examined. A number of strong seedlings were recorded in each sample, but not one of them appeared perfectly healthy and free of lesions. Cotyledons and hypocotyls were badly diseased (apparently anthracnose). We would expect these lots to be disappointing in the field.
(3) Planted in flats in the greenhouse.
(4) Planted in flats in the greenhouse. When planted to germinate in the usual manner, the seed molded over quickly, showing Penicillium and other saprophytes. When these were eliminated with ceresan to facilitate better reading, bacteria were rampant on all of the weaker decadent seeds. Disappointing results in the field are to be expected.
(5) Tested in sand. 50 seed in pans $8\frac{1}{2}$ x $8\frac{1}{2}$ inches. Seed as large as this, 25 seed would be ample for the same size pan.
(6) Greenhouse tests not made under laboratory supervision. Beans become moldy while in tests.

Lima beans are a source of anxiety to many workers in germination laboratories. The large size of the seeds renders them more susceptible to mechanical injury resulting from methods used in harvesting, cleaning, and handling. They are also readily attacked by fungi and decay of secondary nature. Samples Nos. 7 and 8 are good examples of some of the poorer lots of Limas. We only had enough seed of these lots to prepare nine samples of each. One of each was sent to five official laboratories and one of each to four commercial analysts, all of whom have, or were believed to have had, considerable experience in germinating vegetable seed. Results reported are summarized in Table 6.

Results reported by laboratories on each of the samples were tabulated and copies sent to each participant with comments and suggestions.

Samples Nos. 1, 2, 3, and 6 were sent to 28 different laboratories. Samples Nos. 7 and 8 were sent to 9 laboratories.

Fuller cooperation and greater interest in the work were shown in the region during these twelve months than during any similar period in the past.

REPORTS OF THE SUB-COMMITTEES

Report of Sub-committee on Brome Grass Seed Analysis

The purpose of the investigational work with Bromus which has been assigned to our committee is to determine by comparative analyses of five and ten gram samples, whether five grams of Bromus seed is a quantity sufficient for a working sample upon which to obtain dependable results.

This year we have worked with three samples of different quality, - excellent, medium, and poor, - lots No. 1, No. 2, and No. 3, respectively. Each lot was divided in half by one laboratory and this portion used in obtaining subsample "A" for each laboratory. The other portion of the division was sent to different laboratories for division into subsample "B". Number 1 was sent to the Winnipeg laboratory, No. 2 to Minnesota, and No. 3 to Ames. The purpose of having several laboratories cooperate in preparing subsamples was to determine whether different methods of dividing the samples would result in a marked difference in tests. Two methods were used by the cooperating laboratories. A mechanical divider was used by two laboratories, and the two others obtained their subsamples by scattering the bulk uniformly into a large pan and then using a scoop to obtain the desired amount for test.

Table 1. - Analysis of Date from Brome Grass Tests--1939-'40. Percent pure seed with 5-gram subsamples by sample number and by station:

		No. 1	No. 2	No. 3	No. 3A	No. 3B
		%	%	%	%	%
Minn.	A	94.1	89.7	72.9	72.9	68.9
	B	93.5	90.6	68.9	71.3	71.6
N. D.	A-	93.8	88.4	71.3	67.9	70.7
	B	94.1	88.3	71.6	71.2	73.5
Iowa	A	94.0	89.0	67.9		
	B	94.1	88.6	70.7		
Winn.	A	93.9	90.2	71.2		
	B	93.8	89.7	73.5		
Mean		93.9	89.3	71.0	70.8	71.2
X^2		.81	7.13	17.82	9.6	8.03
P		>.99	.40	<.02	.03+	.04

Analysis of the data shows that for sample No. 1 the percentages of purity obtained with brome grass subsamples weighing approximately five grams are remarkably uniform, in fact too uniform for regular occurrence. This uniformity is the more remarkable in that subsamples "A" were prepared by one laboratory, subsamples "B" by a second laboratory, and each of four laboratories tested two of the subsamples.

The subsamples for sample No. 2 also proved to be uniform as indicated by a probability value of .40. Each may be considered as well representing the lot.

The probability value for the tests of subsamples from sample No. 3 is slightly less than .02 which indicates a lack of uniformity. This result is comparable to what has been found previously with five gram subsamples of low grade brome grass seed. Inasmuch as the subsamples marked "A" were subdivided by one laboratory, and those marked "B" were subdivided by another, the eight tests were segregated into two sets of four each. Chi-square and probability values were computed with the result that there is very little difference in variation. It may be said that in this particular experiment there was no significant difference in the results of the subdivision made by the two laboratories that divided the samples although the probability in each case is below .05. One point to be considered is that the pure seed fractions may not be uniform. This can only be determined by making germination tests of the eight pure seed fractions. If one uses the tolerance formula of the association of Official Seed Analysts and the one accepted by the U. S. Department of Agriculture for brome grass in the "Rules and Regulations for the Federal Seed Act," it is found that the results obtained with the set of eight or the two sets of four subsamples of sample No. 3 are within the range of tolerance with one exception as shown in the following table:

Table 2. - High and low percentages of purity and limits allowed below the high figure by two tolerance formulas applied to low quality brome grass.

Formula	Subsamples A & B			Subsamples A			Subsamples B		
	High	Low	Lower Limit	High	Low	Lower Limit	High	Low	Lower Limit
A.O.S.A.	73.5	67.9	68.0	72.9	67.9	67.3	73.5	68.9	68.0
U.S.D.A.	73.5	67.9	67.8	72.9	67.9	67.1	73.5	68.9	67.8

It is believed that when the problem of mixing low quality brome grass uniformly is considered the results obtained usggest that for such lots a five gram sample may be considered adequate for giving a close approximation to the purity. In addition, the data show that with high quality samples the results with five gram subsamples are remarkably uniform and well within normal range of variation. - Edith C. Higgins, Chairman.

Report of Sub-committee on Evaluation of Weed Seeds; the Viability of Injured Weed Seeds

The sub-committee studying the effect mechanical injury and immaturity have on the viability of certain weed seed rounded out another year of interesting research. While reports on all of the assignments were not received, those received contain very useful data.

Sub-committee members and their respective assignments were as follows:
Louisa Ames Kanipe, Corvallis, Oregon, Rumex spp.
Verna Jane Thompson, Ames, Iowa. Amaranthus spp.
Jennie S. Jones, Richmond, Virginia. Allium vineale (bulblets); Digitaria spp.
A. C. Heise, Winnipeg, Canada. Ambrosia artemisiifolia and Setaria viridis.
Geo. C. Morris, Madison, Wisconsin. Agropyron repens.

It was suggested to the sub-committee that if optimum requirements for satisfactory germination of the seeds in question had not been determined, work should be confined largely to mature uninjured seeds. After the essential requirements of these specific kinds are better understood, work on immature and damaged seeds can be carried on more intelligently.

Contributions were received from three of the above named members on four kinds of weed seeds. They are herewith presented as distinct pieces of work each under the author's name and with a conclusion. - C. M. Bass, Chairman.

The Plant Producing Value of Injured Seeds of Rumex spp.*

Louisa Ames Kanipe
Oregon Agricultural College
Corvallis, Oregon

The committee for Evaluation of Weed Seeds in 1939 studied the germination requirements of uninjured seed of Rumex spp. It was found that normally ripe uninjured seeds of the Rumex spp. were not especially sensitive to substrata or temperature but germinated rapidly with a high percentage of viability. The study in 1940 was intended to determine the plant producing value of seeds which showed various types of injury.

In order to secure types of seed injury which occur in normal handling, seed was selected from three samples representing commercial lots of clover. These lots were harvested and received for test in 1939. The Rumexes studied were probably of the following species: Rumex crispus, Rumex obtusifolius, and Rumex salicifolius.

For the purpose of this discussion the achenes of Rumex spp. are referred to as "seeds". In cases where the pericarp has been removed, leaving the true seed exposed, "decorticated seed" has been applied, as these terms are more often used in analytic and trade circles.

The available seeds were divided into two major groups; one consisting of seeds retaining the seed coat (pericarp), and the other consisting of seeds without the seed coats. Each of these groups was subdivided. The seeds retaining their coats were divided into two classes; regular or lens shape, and slightly damaged. The group of seeds without seed coats was divided into four classes; decorticated, damaged bases, slightly damaged embryos, and severely damaged embryos. Seeds were placed on paper towling in petri dishes and germinated at alternating temperatures of 20 to 30° C. The alternation of temperature was obtained by transferring the tests from one chamber to another. The germination results are recorded below.

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Rumex spp.

Sample Number	Type of injury	Number of seeds used	Normal sprouts	Per-cent	Abnormal sprouts	Per-cent	Dead seed	Per-cent
69081	Seeds with coat							
	Regular	10	10	100	0	0	0	0
	Lens shape	10	10	100	0	0	0	0
	Seed coat							
	Slightly damaged	10	9	90	1	10	0	0
	Seeds without coat							
	Decorticated	10	8	80	2	20	0	0
	Damaged bases	10	2	20	8	80	0	0
	Slightly damaged embryo	10	2	20	8	80	0	0
	Severely damaged embryo	10	0	0	2	20	8	80
73137	Seeds with coat							
	Regular	10	5	50	3	30	2	20
	Seed coat							
	Slightly damaged	10	8	80	1	10	1	10
	Seeds without coat							
	Decorticated	10	4	40	6	60	0	0
	Damaged bases	10	1	10	8	80	1	10
	Slightly damaged embryo	10	3	30	7	70	0	0
72885	Seeds without coat							
	Decorticated	10	7	70	3	30	0	0
	Damaged bases	10	0	0	7	70	3	30
	Slightly damaged embryo	10	1	10	9	90	0	0
	Severely damaged embryo	10	0	0	3	30	7	70
TOTAL	Seeds with coats							
	Uninjured	30	25	83.33	3	10	2	7.67
	Seed coats damaged	20	17	85.00	2	10	1	5.00
	Seeds without coats							
	Decorticated	30	19	63.33	11	36.67	0	0.
	Damaged bases	30	3	10.00	23	76.67	4	13.33
	Slightly damaged embryo	30	6	20.00	24	80.00	0	0.
	Severely damaged embryo	20	0	0.	5	25.00	15	75.00

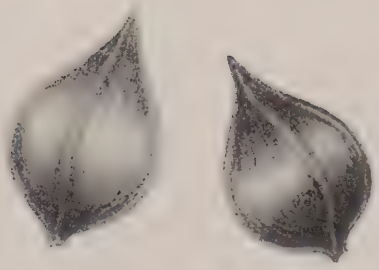
Confirming the results of 1939 the germination results for uninjured mature seeds, see Plate I, gave 83.33% germination, and therefore, should be considered as capable of producing plants and counted in a purity analysis. Seeds having slightly damaged seed coats, see Plate II, and decorticated seed, see Plate III, are 2 classes which indicate significant growth. These gave germination of 85% and 66.33% respectively, which indicates that they are also capable of producing plants and should be counted as normal seed.

The next two classes, damaged bases, see Plate IV, and slightly damaged embryos, see Plate V, gave germination of 10 and 20% respectively, with very high percentages of abnormal sprouts. The value of seeds in these two classes would seed to indicate the possibility of growth, therefore, would be counted in a purity analysis.

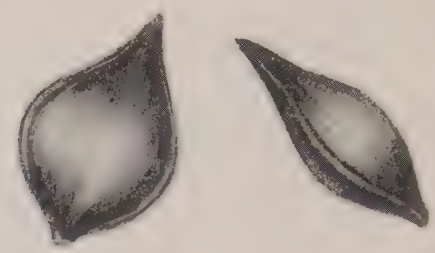
The last class, severely damaged embryos, see Plate VI, gave no germination and a high percentage of dead seed, obviously these are clearly incapable of growth and should be placed with the inert matter.

The results of the study seem to indicate that only seed of Rumex spp. with severely damaged embryos can safely be placed in the inert matter.

PLATE I



(A) Normal Seeds
Regular Shape



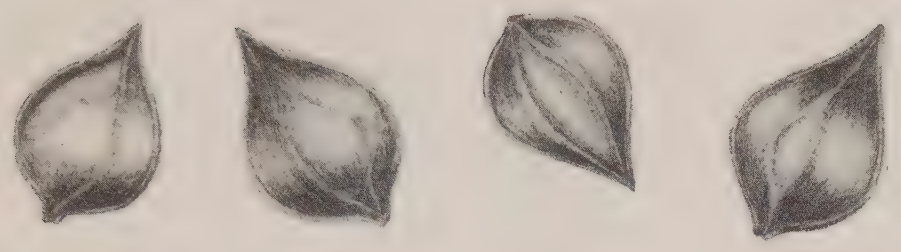
(B) Normal Seeds
Lens Shape

(C) Normal Seedling

Germination Results

30 seeds produced 25 normal seedlings, 3 abnormal seedlings, and 2 seeds were apparently dormant.

PLATE II



(A) Normal seeds having slightly damaged seed coats

(B) Normal Seedling

Germination Results

20 seeds produced 17 normal seedling, 2 abnormal seedlings, and 1 seed was apparently dead

PLATE III

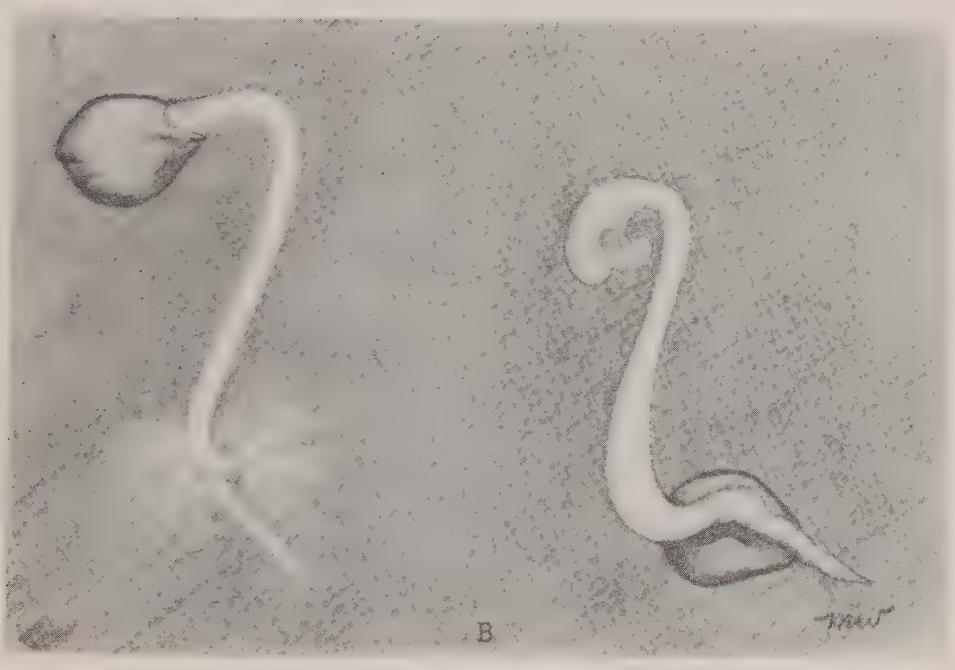
(A) Decorticated Seeds

(B) Normal Seedling
Germination Results

30 seeds produced 19 normal seedlings, and
11 abnormal seedlings..

PLATE IV

(A) Decorticated seeds having slightly damaged bases



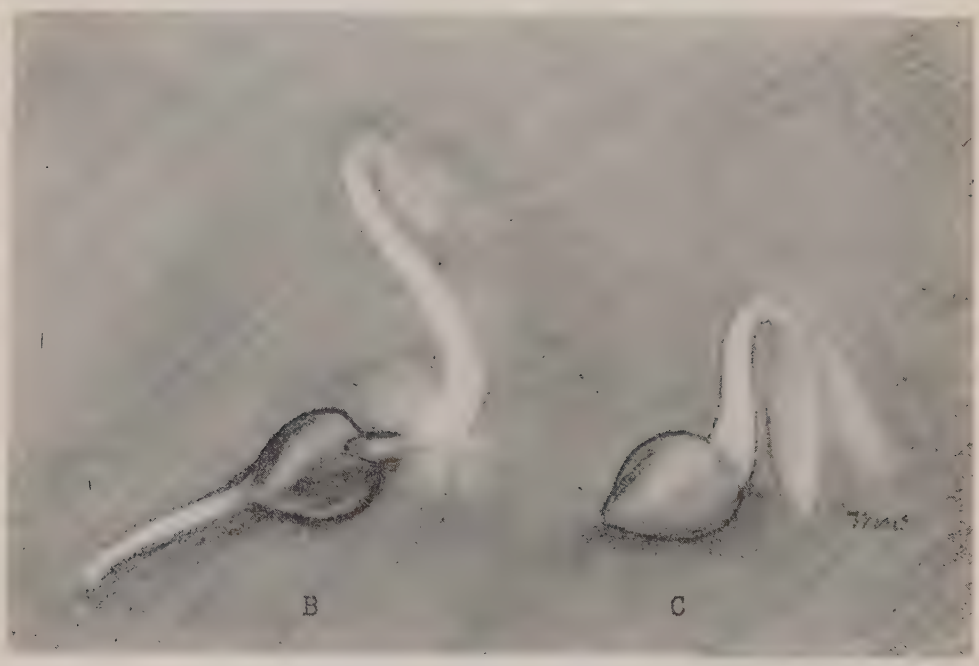
(B) Abnormal Seedlings

Germination Results

30 seeds produced 3 normal seedlings, 20 abnormal seedlings, and 4 were apparently dead.

PLATE V

(A) Decorticated seeds having slightly damaged embryo



(B) Slightly abnormal seedling

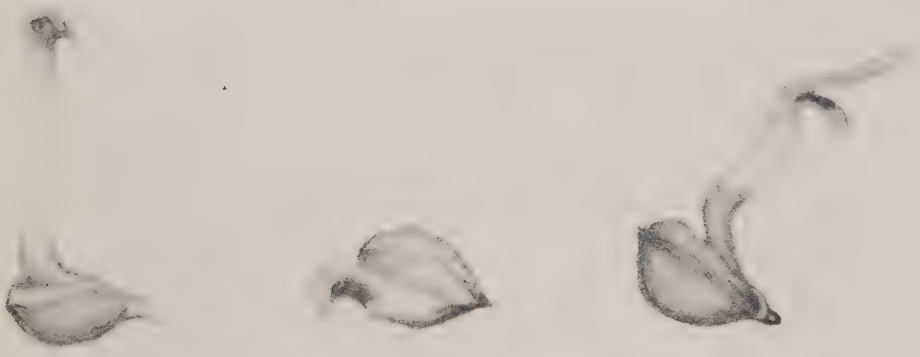
(C) Abnormal seedling

Germination Results

30 seeds produced 6 normal seedlings, and 24 abnormal seedlings.

PLATE VI

(A) Decorticated seeds having severly damaged embryo



(B) Abnormal Seedlings

Germination Results

20 seeds produced 5 abnormal seedlings, and
15 were apparently dead.

Summary Report of Three Years Work.

Verna Jane Thompson, Ames, Iowa.

Amaranthus spp.

Description of seed	Germ. 1938	Germination 1939				Germ. 1940
	20-30°C	20°C	20-30°C	20-30°CL	30°C	20-30°C
	%	%	%	%	%	%
Screenings No. 1 1937 seed						
Unbroken	93	48	79	86	95	83
Slightly broken	87					59
Badly broken	60					-
Immature	-					23
Screenings No. 4 1936 seed						
Unbroken	83					71
Slightly broken	48					27
Screenings No. 6 1938 seed						
Unbroken	90					
Slightly broken	59					
Badly broken	7					
Hand picked No. 7 1938 seed						
Unbroken	-	2	54	45	83	89
Immature	-					23
Hand picked No. 8 1938 seed						
Unbroken	-	11	47	59	68	
Immature	-					
Screenings No. 9 1939 seed						
Unbroken	-	64	90	72	77	91
Slightly broken	-	-	-	-	-	60
Screenings No. 10 1938 seed						
Unbroken	89	48	63	79	87	-
Slightly broken	72					
Badly broken	6					

The seed were classified as follows:

Unbroken - seed coat intact
Slightly broken - seed coat less than half removed
Badly broken - seed coat half or more removed
Immature - shriveled, immature seeds

The samples dis not contain a sufficient number of each of these classes to made complete tests for all three years. Only the available material was used; using 4 x 100 seeds for each test.

The badly broken seed in Nos. 6 and 10 were severely damage, with, in most cases, the entire seed coat removed and the seed injured. Those in No. 1 had only

over half the seed coat removed, often with no apparent injury to the seed itself.

In cases where seed were tested boty in 1938 and 1940, there was a decrease in germination, especially in broken seeds.

Ambrosia artemisiifolia and Setaria viridis

A. C. Heise, Winnipeg, Canada

Tests on common ragweed and green foxtail were begun with several well defined ideas. It was found that they were not adequate and that the tests should be continued by the same analyst. The damaged seeds were from the same samples as were the undamaged. This is essential; the comparison of damaged seeds must be made with the original viability in view.

It was surprising to find that certain temperatures provided more ideal conditions than others.

In some tests, mould overran the substrata, while in others, individual seeds were covered with mould. This condition made evaluation of normal seedlings difficult; in some cases, impossible. It is suggested that in future testing, sterilization with a surface sterilant such as dilute ceresan be tried.

It will be noted that in some tests, a percentage of the seed is reported ungerminated. These were firm seed at the end of the twelfth day count, showing indications of having imbibed water and yet showing no signs of germination.

Before planting any of these seeds, they were all examined under a binocular, both the damaged and undamaged seeds, to determine the classification under which they would be reported.

The following are the results obtained on the several samples tested.

Common Ragweed (M) Ambrosia artemisiifolia

Germination count at 12 days	Normal %	Abnormal %	Dead %	Ungerm. %
With hull undamaged				
Top B. 18-20°C, light (mouldy)	22	0	22	56
Top B. 20-30°C, light (mouldy)	27	0	50	23
Sat. sand petri dish 20-30°C, light	24	3	--	many
Hull cracked, seed undamaged				
Top B. 18-20°, light (49 seeds)	38	0	15	47
Sat. sand 20-30°, light (39 seeds)	26	5	--	--
Without hull, seed undamaged				
Top B. 18-20°, light (mouldy)	12	27	61	0
Top B. 20-30°, light (mouldy)	8	18	74	0
Sat. sand 20-30°, light (mouldy)	7	10	--	--
Without hull, undamaged flat seeds				
Top B. 18-20°, light (50 seeds)(mouldy)	6	50	44	0
Sat. sand 20-30°, light (39 seeds)	23	21	--	--
Without hull, slightly damaged				
Top B. 18-20°, light (mouldy)	5	6	89	0
Sat. sand 20-30°, light (mouldy)	2	--	--	--
Pieces, more than one half				
Top B. 18-20°, light (87 seeds (mouldy)	0	5	95	0
Sat. sand 20-30°, light (50 seeds) (mouldy)	0	2	--	--
Pieces, one half or less				
Top B. 18-20°, light (23 seeds) (mouldy)	0	4	96	0
Sat. sand 20-30°, light (22 seeds) (mouldy)	0	4	--	--

Common Ragweed 7285

Germination count in 12 days	Normal %	Abnormal %	Dead %	Ungerm. %
With hull undamaged Top B. 18-20°, light (50 seeds)	0	0	100	0
Hull cracked, seed undamaged Top B. 18-20°, light (13 seeds)	0	8	92	0
Without hull, seed undamaged Top B. 18-20°, light (mouldy)	0	1	98	1
Without hull, slightly damaged Top B. 18-20°, light (11 seeds) (mouldy)	0	0	100	0
Pieces, more than one half Top B. 18-20°, light (13 seeds) (mouldy)	0	0	100	0
Pieces, one half or less Top B. 18-20°, light (19 seeds) (mouldy)	0	0	100	0
Green Foxtail Setaria viridis 4221				
With hull undamaged Top B. 18-20°, light	64 62	1 5	5 5	30 28
Top B. 20-30°, light	86 85	2 4	2 0	10 11
Sat. sand petri dish 20-30°, light	79	-	-	-
Without hull, undamaged Top B. 18-20°, light (33 seeds)	48	18	34	0
Sat. sand petri dish 20-30°, light (33 seeds)	42	21	-	-
Without hull, embryo damaged Sat. sand 20-30°, light (8 seeds)	12	-	-	-
Green Foxtail 6396				
With hull undamaged Top B. 18-20°, light	17 19	6 8	32 36	45 37
Top B. 20-30°, light	38 29	3 2	36 36	23 33
Partly hulled, caryopsis undamaged Top B. 18-20°, light (50 seeds) (mouldy)	2	10	88	0
Without hull, undamaged Top B. 18-20°, light (12 seeds) (mouldy)	17	0	67	16
Without hull, caryopsis immature Top B. 18-20°, light (12 seeds) (mouldy)	0	0	100	0
Without hull, embryo badly damaged Top B. 18-20°, light (7 seeds) (mouldy)	0	0	100	0

Report of Sub-committee on Hard Seeds

The work which has been done on hard seeds the past year has had to do with seeds which have hitherto received comparatively little attention from the standpoint of evaluating the hard seeds. These seeds, together with the members of this committee who have been working with them are:

Sweet peas - Novah Bennett
Lespedeza - J. W. Woodside
Oxytropis tenella and white clover - W. O. Whitcomb

Miss Bennett and Mr. Woodside have prepared papers giving the results of their studies and these will be presented as a part of this report. Miss Alma Everard has assisted Miss Bennett in her work by furnishing some sweet pea seeds for study.

Oxytropis tenella is a plant which was found growing under uncultivated conditions in Ruby Valley, Montana. This plant resembles vetch and is a perennial which is adapted to swampy land. In recent years it has been brought under cultivation and some difficulty has been experienced in obtaining a stand because of the high percentage of hard seeds. Preliminary studies have shown that these hard seeds are very resistant and do not respond to some of the methods of treatment which have been found successful with other seeds. Likewise, the percentage of hard seeds is not materially reduced by a storage at ordinary temperatures. Experiments on the treatment of this Oxytropis tenella seed are under-way, but sufficient results have not been obtained to report at this time.

White clover seed has been found to contain rather high percentages of hard seeds and some results of treatment have been reported in previous years. It has been found that these seeds do not lend themselves to treatment by scarifying as well as do the other clovers which have larger seeds. Recent information from New Zealand indicates that the hard seed problem in white clover is an important one and that little or no work has been done on it there. Some special samples of white clover have been obtained from New Zealand and work is not being done on these.

New Methods of Treating Hard Seeds

Several methods of treating seeds to reduce the hard seed content have been suggested. The first of these, scarifying, has been in use since 1894, and is still finding favor as a commercial practice. The second, treatment with sulphuric acid, was first used in 1898 and has been employed from time to time in experimental work with hard seeds but has not been found practical in a commercial way. The use of heat has been employed in various ways since Schneider--Orelli suggested it in 1910. In 1932, Hamly suggested the use of mechanical impaction of the seed as a means of opening the strophioler cleft of the seed and thus admitting water to the germ. This principle seems to have merit and is being tried in various ways.

Some recent work at the Montana seed laboratory has indicated the possibility of reducing the hard seed content by means of treating seeds with rather dilute solutions for varying lengths of time. The solutions which are being used are soil extracts, acids, alkalies, and ferments. It is believed that varying the temperatures will have an influence on the activity of these solutions. -

W. O. Whitcomb, chairman

Report of Sub-committee on Methods Analyses of Small Seeds

When the sub-committee actually became organized and began its work late in the year it was found that the Association at its last meeting in Madison, left definite instructions upon but one project, namely "that a further study be made of the occurrence of chalcis fly injury in alfalfa seed". The chairman, upon appointment, immediately got in touch with all those who had expressed any interest in this problem. It was finally found that at least three members had undertaken a definite study of the problem. Their findings together with recommendations are herewith presented as separate contributions.

Additional Projects

Problems attendant upon the the analysis of Dallis grass as suggested to the sub-committee were referred to a Southern laboratory, but unfortunately sufficient work was not possible to warrant a report at this time.

Dr. Leggatt, a member of the committee, in efforts to unify methods of analytical technique, was undertaking a study of what was termed the "climax" blowing point for various species of grass seeds. A condensed report is as follows.

Condensed Report on Climax Blowing Point for Grass Seed

Certain considerations led to the belief that if samples of grass seed were blown with progressively increasing pressure and the heavy portion at each stage counted and set for germination, the "pure live seed" figures so obtained would show a series of increasing values up to a maximum or climax after which they would begin to decrease. It is held that the only valid estimate of pure live seed is the highest point obtainable in such a series since this estimate is usually interpreted in terms of pounds per hundred of live seed and no figure short of the highest reveals its true value.

An extensive series of experiments with Kentucky bluegrass showed that such climax-point does exist and that, with samples of widely different quality, it occurs at a blower setting sufficiently close in all cases to be used as a standard blowing. The setting is somewhat higher than that which corresponds to the ordinary idea of pure seed so that some florets with small caryopses are blown over. These would be discarded since they may be considered as not "pulling their weight" in the pure seed fraction because their presence in it only serves to lower the value of the pure live seed figure, even though some of them may germinate. -

C. W. Leggatt

The Preparation of Schedules of Uniform Blowing Pressures or Gate Openings for Seed Blowers

Because of the experience she has had in comparing the modified method with the official method of analyzing grass seeds, Mrs. Torpy of the Federal seed laboratory, was asked to continue a similar line of study for the association and to compare, if possible, the different types of blowers in use. This was thought necessary in order to arrive at some definite conclusion as to what needs to be done in the future in order to clarify the question of which type of seed blowers shall be used to eliminate the factor of personal variation. Her preliminary report is as follows:

"Due to the unusually heavy work here in the Federal laboratory this year, it has been impossible to make an exhaustive study of the different blowers. However, some work was done and, as a result, the following tables are suggested as schedules for the various types of seeds mentioned. Time was not available to compare the different blowers, therefore, efforts were concentrated on the Leggatt blower which was found most satisfactory.

	Kind of Seed					
	Axonopus compressus	Poa nemoralis	Festuca species	Festuca rubra	Paspalum dilatatum	Agrostis species
	6.75	4.50	9.75	6.50	5.00	2.50
	7.00	4.75	10.00	7.20	6.00	3.50
Gate	7.75	5.00	10.50	8.20	6.50	3.70
Openings	8.00	5.20	11.00	9.00	6.60	4.00
	8.50	5.40	11.20	10.00	6.70	4.15
	9.00					

The Festucas vary a great deal in the requirements for blowing. Each sample must be handled individually and blown accordingly. Paspalum dilatatum, being a pubescent seed, is very difficult to blow. Any blowing done is merely an aid in doing the purity analysis because each blowing must be carefully examined and picked over no matter how well it is blown.

In this laboratory, all blowings are examined but with the Leggatt blower there is very little picking, except to pick out weed and other crop seeds. In many samples there are no pure seed in the last blowing, but very often there are and these must be picked out. We do not feel that it is wise to eliminate carefully examining the blowings for pure seed no matter how good the blower may be. A good blower merely cuts down the amount of hand picking necessary and by so doing shortens the time of the test.

The ten-minute schedule of blowing given with the Leggatt blower was not found to be necessary or materially helpful. It does no harm except consume more time. My experience has been that shorter periods of blowing are just as effective.

It is hoped that in the future more time may be available to follow up these schedules and, perhaps at a later date, it will be possible to give better schedules for more kinds of seeds, and also a comparison of tests on the different kinds of blowers as well. - Frankie-Jo M. Torpy"

The General Referee Bluegrass Sample

As the contribution of the chairman to this general project further study in theory and practice was made of the shorter and so-called "binocular method" of arriving at the pure seed content of bluegrasses. This project was started some time ago but was continued in part under the work of this sub-committee thru the sending out of controlled samples of Poa pratensis seed in which an attempt was made to eliminate everything from the sample which did not bear upon the project. Those who participated were invited to also undertake a trial analysis with the proposed binocular method. The results are definitely discussed in the reports to the participating laboratories (See supplemental report on "Some Comparative work with Kentucky Bluegrass Seed.") and in part in the formal article herein presented on page 79.

In connection with this general referee sample of bluegrass seed participants were invited to answer certain questions designed to aid the sub-committee in its study of practices now being followed.

Replies concerning the use of blowers, of which there are now at least six different and distinct types in use, showed a wide divergence of opinion as regards their usefulness. The results reported do not indicate that definite uniformity between laboratories using the same type of blower is now being obtained in all instances. In this connection it was apparent that those who used the newly suggested binocular method and who did so critically and who had adequate equipment to do so were more uniformly consistent in their results and nearer to the known purity of this stock than were those who made much of the type of blower being used to secure such percentages. All in all there appeared much to commend the binocular method for general use. Likewise, in the answers to other questions asked there was a wide divergence of opinion, as well as of laboratory practice. For instance, practically half of the laboratories reported that they regularly did not use either a binocular or reflected light with which to check their bluegrass pure seed or inert material separations. Yet all of the laboratories reported that they regularly use some form of blower to aid in making the separations. Just how much effect these practices have on results is difficult to determine. They may have much to do with the seemingly wide variations in results, yet in actuality they may be more apparent than real considering the commodity being handled.

Finally it does not seem clear at the present moment as to just what definite recommendation the committee can make to the Association. It is evident that we have not arrived at a solution to the question acceptable to everyone and the subcommittee is continuing its efforts. One thing appears consistently apparent and that is that all workers should first get clearly in mind what they are trying to do when making a pure seed determination under the present rules and on that basis make an effort to so work in practice that their results will be consistent with the kind of seed used and within the limitation of the sample. If greater uniformity in results is possible and is to be secured by making infallible the pure seed separation process then it, like all other similar determinations, must be achieved by employing some adequate device which will operate with equal surety and uniformity in every laboratory. - Bette Cullinan, chairman.

The Iowa Experimental Method for Purity Analysis of Chalcis-fly Infested Red Clover and Alfalfa Seeds

Wayne A. Robbins, Iowa Agricultural College, Ames Iowa

The Iowa method of testing small seeded grasses as described in a number of publications is based on the principle that uniform air pressure removes empty, light weight, and questionable florets in a uniform manner. It has further been stated by Porter (1) "The retention of such florets in the pure seed fraction causes a decrease in germination that is disproportionate to the increase in purity. Laboratory tests of all seeds will more nearly represent the value of seed lots if the unit weight of living and viable seeds in the pure seed fraction is approximately the same. Percentages of purity are based on weight, whereas percentages of germination are based on number. The most practical way in which purity and germination data can be used together is to use them to determine the number of pounds per hundred of pure live seed. This may be accomplished by the simple

(1) Porter,R.H. "Purity Analyses of Small Seeded Grasses" prepared for A.O.S.A. Handbook. 1939.

procedure of multiplying the percent pure by the percent germination and dividing the product by 100. The figure obtained is correct only when the unit weights of the living and dead seeds in the pure seed fraction are the same. The retention of light weight, immature and badly shriveled seeds (most of which are non viable) with the heavy seeds increases the difficulty of determining the number of pounds per hundred of pure live seed. The modified method of determining purity of small seeded grasses commonly gives a purity lower than may be obtained by the official method but the germination is usually higher and the product of the two values is greater by the modified than by the official method."

The above principle seemed applicable to chalcis-fly infested clover and alfalfa seeds which, if tested by the official method, would be contrary to the above principle. Accordingly, an attempt was made to separate chalcis-fly injured seed from normal seed by means of the Iowa Air-blast separator. It was assumed that there would be sufficient differences in specific gravity to permit a separation through the use of an air-blast of uniform pressure. Preliminary investigations were made to determine the proper blowing schedule.

A five gram sample of chalcis-fly infested red clover seed was blown at regularly increasing pressures until visual examination showed that almost all of the injured seed has been removed. It was found that all of the material removed at a dial reading of 47½ consisted of injured seed. A few shriveled, but apparently normal, seeds were removed at a dial reading of 50, however, most of the material was injured seed. The most satisfactory blowing schedule was:

Time	3	min.	Dial Reading	45
"	3	"	" "	47½
"	3	"	" "	50

The material removed at the top blowing of 3 minutes at 50 reading on the dial was handled separately so as to facilitate checking with the binocular.

Using the above schedule, duplicate, five-gram samples of red clover were blown. In each case about five chalcis-fly injured seeds remained in the heavy portion; these were removed and put with the inert portion. Each portion was placed to germinate to test the accuracy of the separation (See Table 1). Two-hundred seeds of the heavy (pure) fraction were placed between blotters at 20° C. The few shriveled, good seeds which were removed at the top pressure were separated from the light (inert) fraction and placed between a blotter to test their viability, as was also the remaining light portion.

Table 1 shows uniformity in the germination of the pure fractions of the two subsamples. The inert fractions also showed uniformity. In each case only one normal seedling developed from the inert fraction out of an estimated 116 seeds present. The shriveled, but apparently normal, seeds removed from the inert fraction were of low viability and light in weight. Thus the retention of such seed in the pure seed fraction reduces the germination out of proportion to the increase in purity.

Using the same method, duplicate subsamples of alfalfa were blown and the separations germinated. (See Table 1). In this case many shriveled, good seeds of low specific gravity were removed with the chalcis-fly injured seed. The less definite separation of alfalfa by blowing is shown by the germination test.

For further experiments, two five-gram subsamples were drawn from each of five red clover and one alfalfa samples. In each case, one of the two subsamples was analyzed according to the official rules for seed testing; the other subsample was analyzed by the method outlined above. Seeds with intact seed coat and over one-half in size were considered as pure seed in the analyses of the

Table 1. - Results of Employing the Iowa Experimental Method on Samples of Red Clover and Alfalfa Seed Infested with Chalcis-fly

Sample	Test	Germination of pure				Germination of good				Germination of inert			
		Strong	Weak	Dead	Hard	Strong	Weak	Dead	Hard	Strong	Weak	Dead*	Hard
		%	%	%	%	%	%	%	%	%	%	%	%
Red Clover #2	I	64	2	5	29	3	0	1	2	1	0	115	0
Red Clover #2	II	65	0	5	30	3	0	3	2	1	1	115	0
Alfalfa #6	I	75	3	8	14	46	12	47	8	0	0	30	0
Alfalfa #6	II	78	2	7	13	10	5	12	5	1	0	37	0

Table 2. - Comparison of Official and Iowa Experimental Methods of Testing Red Clover and Alfalfa Seed Infested with Chalcis-fly

Sample	Method	Purity				Germination				Germination of inert			
		Pure	Crop	Inert	Weed	Strong	Weak	Dead	Hard	Strong	Weak	Dead	Hard
		%	%	%	%	%	%	%	%	%	%	%	%
Red Clover #1	Official	96.55	1.44	.89	1.12	58	3	30-1/2	8-1/2	1	3	20*	0
" " "	Exp.	84.26	.96	13.76	1.02	78-1/2	4-1/2	7-1/2	9-3/4	2	7	300*	0
Red Clover #2	Official	99.46	--	.21	.33	58-1/2	5-3/4	12-3/4	23	0	0	4	0
" " "	Exp.	95.04	.02	4.94	--	63	3-1/2	2-1/2	31	1	1	150*	0
Red Clover #3	Official	99.48	.25	.02	.25	70-1/4	4	4	21-3/4	0	0	1	0
" " "	Exp.	98.11	.39	1.24	.26	75	4-1/4	2	17-3/4	1	1	30*	0
Red Clover #4	Official	96.32	trace	1.47	2.21	76-3/4	5-3/4	7-1/4	10-1/4	0	0	40*	0
" " "	Exp.	95.24	.02	2.96	1.78	81-1/2	5-1/4	4-1/4	9	1	2	80*	0
Red Clover #5	Official	98.97	.20	.79	.04	60	10-1/4	14	15-3/4	0	0	12	0
" " "	Exp.	96.94	.33	2.73	--	69-1/2	9-1/4	7-1/2	13-3/4	0	2	70*	0
Alfalfa #6	Official	99.45	.02	.31	.22	69-1/2	6-1/2	12-1/4	11-3/4	0	1	4	0
" "	Exp.	97.52	.02	2.16	.30	72-1/2	9	6-3/4	11-3/4	0	4	35*	0

*Estimated.

subsamples by the official method. The results obtained are shown in Table 2. As to the purity, the official method was consistently higher in per cent pure than the Iowa experimental method, and as a result the Iowa experimental method gave a consistently higher per cent inert matter. In the germination test, 400 seeds from the pure seed fraction were placed between blotters at 20°C and all of the inert matter was placed between a blotter to test the viability of the seeds removed from the pure seed fraction. The Iowa experimental method gave a higher per cent normal germination in all cases tested. The germination of the inert fraction showed that an accurate separation was being made through the use of the air-blast separator The experimental method removed many chalcis-fly injured seeds which were incapable of germination but which would be left in the pure seed fraction according to the official rules.

The data indicate that through a combination of a controlled air blast and visual examination of the small portion removed by the separator at the top pressure a practical, time-saving method of separation is possible. The response of alfalfa to the experimental method is not as well defined as that of red clover yet, by the use of the binocular, it is possible to make a reasonably accurate separation of the small amount removed at the top pressure. The value of this method is that, at any period of the year, all seed with a given degree of chalcis-fly infestation would be removed from the pure seed fraction and, although the percentage of purity would be reduced as the season advanced, the percentage of germination might be expected to remain fairly constant.

Some Problems in the Analysis of Chalcis-Fly Infested Red Clover and Alfalfa Seed[1]

Peggy Hayes[2]
Agricultural Experiment Station
Corvallis, Oregon

The Chalcis-fly has for years been a serious factor in the production of alfalfa and red clover seed. The adult chalcis-flies deposit eggs in the undeveloped seeds, where they hatch and develop through the larval and pupal stages to adult flies which emerge after consuming the contents of the seed.

Since the life cycle is not always completed when seed is harvested there is great variation in the amount of injury to the seed. When this seed is being analyzed several problems arise: (1) to determine whether or not infested seeds can be separated from normal seeds by blower-type cleaning machines, and (2) To determine whether or not injured seed containing the larval stage should be placed in the pure seed or inert matter.

In 1939, studies were made on five samples of red clover and six samples of alfalfa representing commercial lots of seed received by the laboratory for testing. In order to determine whether or not infested seeds could be separated from normal seeds by blower-type cleaning machines, triplicate 5-gram tests were made on red clover and duplicate tests on alfalfa. Each 5-gram sample was blown to remove the lightest seeds. The chalcis-fly injured seeds were then separated by hand from the blowings and from the heavier seed. They were counted and weighed, and the average weight of each seed computed. The results are shown in Tables I and II.

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[1]Published as Technical Paper No. 343, with the approval of the Director of the Oregon Agricultural Experiment Station. Contribution from the Department of Farm Crops.

[2]Seed Analyst, State Seed Laboratory. Acknowledgment is given to Lucille Lindsay and Jenetta Blodgett for their assistance in the purity analyses.

Table 1. - A Comparison of the Weights of Normal Seeds and Seeds Containing Chalcis-Fly Larvae in Trifolium Pratense - Red Clover

Sample number	Average weight of normal seed	Infected seed removed by blowing from triplicate 5 gram separations		Infected seed not removed by blowing from triplicate 5 gram separations	
		Number removed	Average seed weight	Number removed	Average seed weight
	mg.		mg.		mg.
65842	1.56	95	0.88	7	1.29
		65	0.94	10	1.22
		133	0.92	5	1.40
65843	1.55	180	0.86	32	1.13
		97	0.75	13	1.15
		73	0.84	9	1.67
66070	1.70	106	0.95	56	1.16
		208	1.02	17	1.12
		161	0.98	35	1.32
67673	1.69	10	1.22	3	1.33
		10	1.30	0	-
		11	1.09	1	2.00
67709	1.65	6	1.00	2	1.50
		9	1.00	1	2.00
		11	1.00	3	1.33
Mean	1.63	78.33	.98	12.93	1.40

Table II. - A Comparison of the Weights of Normal Seeds and Seeds Containing Chalcis-Fly Larvae in Medicago sativa - Alfalfa

64261	1.76	1.	1.00	2	1.50
		2.	1.00	2	2.00
65830	2.32	14	1.00	9	1.44
		27	0.93	2	2.00
65888	1.68	0	-	0	-
		0	-	1	2.00
65993	1.56	15	0.93	2	2.00
		10	0.88	5	1.50
65994	1.69	3	1.33	3	1.67
		10	1.10	4	1.75
66615	1.65	44	1.10	0	-
		51	1.10	0	-
Mean	1.78	14.75	1.03	2.5	1.76

Table 3. - Only Chalcis-Fly Injured Seed With Broken Seed Coats Removed to the Inert Fraction. Method 2

Sample Number	Germ.	Hard	Germ. & hard	Pure seed	Pure live seed
	%	%	%	%	%
73611	14.50	3.25	17.75	99.71	17.70
71167	45.75	36.25	82.00	95.49	78.30
73303	43.25	18.00	61.25	96.63	59.19
73483	39.50	4.25	43.75	98.94	43.29
73486	54.00	5.50	59.50	99.24	59.05
73614	37.00	6.75	43.75	86.62	37.90
73742	65.75	27.25	93.00	98.58	91.68
73741	62.25	25.50	87.75	98.62	86.54
73804	63.00	20.75	83.75	75.10	62.90
74024	38.25	1.25	39.50	99.21	39.19
74053	44.50	42.75	87.25	96.41	84.12
74054	52.75	39.00	91.75	96.88	88.89
74057	51.75	38.50	90.25	96.47	87.06
74077	79.50	6.75	86.25	94.81	81.77
74307	81.50	13.50	95.00	99.42	94.45
74316	71.75	14.50	86.25	89.14	76.88
74501	72.00	14.50	86.50	73.23	63.34
74516	76.75	19.25	96.00	99.14	95.17
74588	86.75	8.75	95.50	97.89	93.48
74703	85.00	10.25	95.25	98.08	93.42
74718	81.25	8.50	89.75	99.60	89.39
74719	77.50	6.25	83.75	98.82	82.76
74793	76.75	13.25	90.00	99.96	89.96
Mean	60.91	16.71	77.63	95.13	73.76

Table 4. - Sample Blown and all Chalcis-Fly Injured Seed Removed to Inert Fraction. Method 1

71167	54.00	30.50	84.50	93.62	79.11
73303	66.50	12.50	79.00	94.33	74.52
73483	55.00	4.00	59.00	93.96	55.44
73486	68.50	9.50	78.00	96.09	74.95
73611	52.00	9.50	61.50	52.31	32.17
73614	41.50	9.00	50.50	77.71	39.24
73741	58.50	34.00	92.50	97.58	90.26
73742	67.00	24.50	91.50	98.09	89.75
73804	71.50	25.50	97.00	71.53	69.38
74024	40.50	3.50	44.00	87.71	38.59
74053	55.50	35.50	91.00	94.62	86.10
74054	51.50	40.00	91.50	95.79	87.65
74057	48.50	42.50	91.00	94.28	85.79
74077	80.50	12.50	93.00	93.53	86.98
74307	76.00	16.50	92.50	98.39	91.01
74316	74.00	14.50	88.50	88.06	77.93
74501	87.00	8.00	95.00	69.73	66.24
74516	71.00	22.00	93.00	98.69	91.78
74588	86.50	10.00	96.50	98.52	95.07
74703	83.50	8.50	92.00	97.86	90.03
74718	75.00	7.00	82.00	99.42	81.52
74719	80.50	6.00	86.50	98.22	84.96
74793	84.00	10.50	94.50	99.33	93.87
Mean	66.45	23.89	85.85	90.84	76.62

It was found that although many of the chalcis-fly injured seed could be removed by blowing, the method was not entirely satisfactory.

Since blowing did not appear to be dependable, the advisability of other methods was discussed with operators of various cleaning plants. The opinion was that such seed could be removed by vibrator-type machines. With this in mind, the problem developed into one combining cleaning processes and laboratory analytical tests.

Two points of view have been held by various analysts: (1) Since the Chalcis-fly larvae consume the contents of the host seed, they should be classed as inert matter in accordance with that part of the definition in the Rules and Regulations under the Federal Seed Act issued March, 1940, which states that "Any matter other than seeds shall be considered inert matter", and (2) All portions of seeds in excess of one-half should be placed in the pure seed fraction, while only the shells having a hole or being broken in a manner to reveal the larvae should be placed in the inert matter. This procedure is based on "The Quicker Method" of purity analyses in force in North America.

In order to compare these two methods, studies were made on red clover containing varying amounts of infested seeds. Twenty-three different samples received for testing from September, 1939, to March, 1940, were selected for duplicate 5-gram analyses. During the current season the second method enumerated above was followed. (Table 3) In may, 1940, the same samples were again tested, using the first method. The results are recorded in Table 4.

Investigation of the means in these tables indicates that the percentage of pure seed is higher by the second method. (Table 3) The germination and hard seed are higher by the first method, since the injured seeds have been placed in the inert matter and are not counted in the germination test. Commercial interests have indicated that they prefer a higher percentage of pure seed and a lower percentage of germination as these would be more readily accepted by the consumer. However, since the chalcis-fly injured seed can be cleaned out by vibration and air blast the presence of a higher percentage of pure live seed as shown by the means in both tables, indicates that Method 1 is more accurate.

Proposed Changes in the Rules and Recommendations for Testing Seeds as Regards the Disposition of Insect - Damaged Seeds

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As the Rules and Recommendations for Testing Seeds now stand, there is no specific declaration as to where insect-damaged seeds should be placed when making a purity analysis. The staff of the Virginia laboratory feel that an explicit statement concerning insect-injured seed should be made in the definitions of the kind of seed under consideration and of inert matter. We should, therefore, like to propose definitions of these two separations in place of those now given in the Rules and Recommendations for Testing Seeds. None of the Virginia analysts is on the rules committee; therefore, it is possible that our recommendations will conflict with those of that committee. We hope very much that they will not.

It is our proposal that insect-injured seeds be handled as are broken seeds. Our recommendation is that any piece of insect-damaged seed larger than one-half be placed in the pure seed separation and that insect-damaged seeds, when one-half

or less, be placed in the inert matter separation. This is not a drastic change; the simple fact is that if it is practicable to classify broken seeds as either pure seed or inert matter, then it is practicable to separate insect-injured seeds into two parts, the separation being made, as above suggested, on the same principle as broken seeds.

We wish to make it clear at this point that the question of viability has not been considered. Viability, in the case of broken seeds, is ignored. In our opinion, the same policy should be followed in handling insect-injured seeds.

It is true that seeds which are broken are on the whole more readily detected than seeds damaged by insects. It is also true that with the aid of a blower, insect-injured seed may be separated from uninjured seed. Seed samples which upon first examination show insect injury may be blown to a point where all insect-damaged seeds are removed. An examination of these blowings should then be made and the insect-injured seeds put into the respective separations: That is, the kind of seed under consideration, or inert matter. The use of a blower is necessary because of the fact that it is often impossible to determine the degree of injury without pressing the seed between forceps. Obviously, it would not be practicable to check each seed in a test sample. The entire inner portion, however, of a seed may have been destroyed by an insect and the seed coat found to be intact. Due to the different types of blowers in operation in the laboratories of this country and Canada, we believe that each laboratory can best work out its own method of removing from the pure seed seeds that are insect-injured to one-half seed or less.

Recently our laboratory distributed to several other laboratories red clover samples showing a large percentage of chalcis-fly infestation. The following results were received:

Laboratory	Sample No. 1 - Regular method					Sample No. 2 - Proposed method				
	Pure seed	Inert matter	Weed seeds	Other crop seeds	Germination	Pure seed	Inert matter	Weed seeds	Other crop seeds	Germination
	%	%	%	%	%	%	%	%	%	%
A	95.44	1.74	1.45	1.37	65	85.27	12.14	1.14	1.45	81
B	94.50	3.50	0.60	1.40	65	87.60	10.50	0.90	1.00	79
C	96.56	1.05	1.07	1.32	65	83.45	14.47	0.74	1.34	80.5
D	95.71	2.07	1.50	0.72	69.50	85.15	12.43	1.37	1.05	78.25
E	96.37	1.22	1.21	1.20	60	83.49	14.71	0.95	0.85	73.8
F	96.04	1.72	1.03	1.21	50.75	84.20	13.92	1.14	0.74	74.5
G	95.80	1.90	1.00	1.30	54.50	85.39	12.29	1.07	1.25	78
H*	84.26	13.76	1.02	0.96	78.5	96.55	0.89	1.12	1.44	58
I**	83.64	13.95	1.04	1.37	75	83.24	14.43	1.11	1.22	78
J***	96.74	1.00	1.14	1.12	59	95.89	2.05	0.92	1.14	63

*Percentages comparable if reversed, but not arrived at according to the suggested methods.
**The instructions apparently were not followed.
***Since the findings of this laboratory are so different from the others reporting, these percentages should probably be excluded from the table.

These results show that the greater percentage of laboratories reporting were able to remove the chalcis-fly infested seeds, though the seed coats were intact in a large percentage of the infested seeds. Some of the comments accompanying these reports favored our proposed method for handling chalcis-fly; some did not.

Chalcis-fly in red clover and alfalfa is only one of the insects which infest seed stocks. Cowpea weevils do considerable damage to that kind of seed; the vetch bruchid causes damage to vetch; the angoumois grain moth injures wheat; and the cadelle worm causes injury to rye, only to mention a few of the most troublesome insects to seed stocks.

Because the Rules do not specify where such seed should be placed in making a purity analysis, it has been the policy in Virginia to include in the pure seed insect-damaged seed, if it was not apparent externally that the seed was only one-half or less. This policy is entirely inadequate and was only formulated because of the deficiency in the Rules.

Our proposal is that the definitions of the kind of seed under consideration and inert matter in the present Rules stand, with the exception that in both definitions, following the words "broken seeds," the words "and/or insect-damaged seeds" be inserted. The definitions with the suggested changes added are as follows:

(1) Kind of seed under consideration. This should include all seeds of the kind under consideration, whether shriveled, cracked, or otherwise injured; provided, (a) that in case of broken seeds *(and/or insect-damaged seeds), any piece larger than one-half should be included, while pieces that are one-half or less should be considered inert matter; and (b) that seeds of legumes and crucifers with the seed coats removed should be considered inert matter.

(4) Inert matter. Broken seeds *(and/or insect-damaged seeds) when one-half or less; seeds of legumes and crucifers with the seed coats removed; undeveloped and badly injured weed seeds which, upon visual examination, are clearly incapable of growth; dirt, stones, chaff, fungus bodies (such as ergot and other sclerotia and smut balls), and any other matter not seeds, should be considered inert matter:----------.

We strongly urge that the rules committee and the Association as a whole consider the proposed definitions presented. The question of where to place insect-damaged seed has gone unanswered too long.

Addendum

Consideration of the proposal just made is likely to bring out the problem of how damaged other-crop-seeds should be handled when making a purity analysis. The separation designated "other crop seeds" must be handled either in the manner of the kind of seed under consideration or in the same way as weed seeds. We suggest that our proposal concerning insect-injured seeds of the kind of seed under consideration should be discussed and that if there is a change made in the Rules to include seeds showing this injury, the problem of handling damaged other-crop-seeds be brought up following the change. In view of the requirements of the Federal Seed Act and the suggested Uniform State Seed Law, it is more important than before that consideration be given as to where damaged seeds of the other crop seed separation should be placed.

Footnote: The term "insect-damaged seed," as used in the proposed definitions for the "kind of seed under consideration" and "inert matter" shall include seeds injured by insects, nematodes, and other forms of life not considered plants.

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*Words within parentheses constitute the only changes proposed in the two definitions.

Report of Sub-Committee on Relation of Phytopathological Technique to Seed Laboratory Practice

The chairman of the Research Committee appointed G. A. Scott of Ottawa, Canada to the chairmanship of this sub-committee, but because of the pressure of duties incident to the war, he was unable to serve. It was not until late in the fall that a request to place the chairmanship in the Iowa laboratory was received. Consequently, work was not begun until late in the spring following the peak load of service work.

The results obtained with barley and wheat in 1937-38 by members of this committee in which uniform results were obtained with treated seed but not with untreated prompted a trial with corn carrying a given amount of infection with Diplodia zeae. The material was prepared by taking a lot of nearly disease free seed and dividing it into two equal parts, one of which was treated, the other untreated. Similarly, kernels thought to be viable were removed from diseased ears and divided into two parts, one treated, the other untreated. The nearly disease free seed, both treated and untreated, was divided into sub-samples of 90 kernels each to which 10 kernels from the diseased lot of treated and untreated respectively were added. Unfortunately, not all of the kernels from the diseased ear were equally infected and the nearly disease free seed was not 100% clean.

Each laboratory received two 100 seed lots each of the treated and untreated synthetic subsamples. The instructions were to place the seeds of each subsample with the embryo next to the bottom of a glass moist chamber, after which a 2 inch layer of sterile sand was to be added. Requested temperatures were 20-30°C for 6 days and 28-30°C for 4 days more. Readings were to be made on the 3rd and 10th days. Willard Crosier of New York, F. A. McLaughlin of Massachussets, C. Harold Amick of West Virginia and W. D. Hay formerly at Montana, now in the California laboratory, cooperated in making the tests.

Table 1.-Summary of Referee Tests with 10% Diplodia - infected corn seed - 1939-40*

Results in 3 days	Untreated Sample %	Treated Sample %
Seeds germinated	77(56-92)	84(62-94)
Seeds not germinated	23(8-44)	16(6-38)
Seeds germinated, fungus present	0.4(0-1.5)	0.25(0.-1.0)
Seeds not germinated, fungus present	3.0(1.0-4.0)	1.25(0.5-2.0)
Results in 10 days		
Seedlings emerged	91(89-96)	93(92-95)
Seeds not germinated plus seedlings not emerged	9.6(7-11)	66(5-8)
Seedlings emerged and blighted	10.6(0-23)	23(0-9)
Infected seeds	47.(13-90)	11(4-27.5)
Seedlings with necrotic lesions on stems or roots	44(7-93)	20(0-56.5)

*All results are averages and ranges from 4 laboratories

Discussion of Results

With possibly 8 exceptions, the differences between replicates in any given laboratory are not significant, hence the mean was calculated and recorded for each pair of 100 seeds. As between laboratories the differences for all features on the third day are highly significant for the untreated seed. For the treated seed the differences are not significant for the percentage of infection observed, but differences for germinated seeds are significant. The technique in counting the germination in 3 days differed with the laboratory.

A study of the results on the tenth day show that close agreement as to seedlings emerged and not emerged occurred for both treated and untreated lots with the exception of "W" laboratory. For the pathological readings wide differences of interpretation for untreated seeds are apparent and the same is true for the treated but to a less extent. Treated seeds did, however, give a higher percentage of emergence, a lower percentage of ungerminated seeds, fewer blighted seedlings and a much lower percentage of seedlings with necrotic lesions.

The wide differences in the percentages of infected seeds in the untreated lots is probably explained by failure in the initial instructions to make it clear that only seeds with clear evidence of infection with Diplodia zeae were to be recorded as infected. Undoubtedly organisms other than Diplodia zeae confused the observations to some extent. The percentages of seedlings with necrotic lessions on stems or roots as recorded by the members of the committee also differ widely. It is to be expected that if only a few seeds carried initial infection with Diplodia zeae the intertwining of roots would result in the development of lesions but the spread should have been more uniform. No explanation of the differences is offered except the possibility of variation in personal interpretation of what constitutes lesions.

In general, it may be said that treatment of this lot of corn resulted in higher germination, less infection with organisms and smaller differences of opinion as to interpretation of results. Further tests with other crops are recommended. - William N. Rice, Chairman

Sand as a Substratum for Germination Tests

The referee work for region No. 3 included an extensive series of sand tests which have already been discussed. It appears that it is desirable to send out detailed instructions for conducting sand tests from time to time it being apparent that a uniform method has not been followed in many cases; possibly on the part of some from failure to consult instructions which have already been issued or to follow them closely. It is also recognized that the material used was not entirely satisfactory, a seed softening as readily as alfalfa having proved unsuitable for a study of this sort.

It is recommended that further series of similar tests be sent out, care being taken to attend to these points since it has been shown in region No. 3 that, where instructions are closely followed, sand tests can be more uniform than blotter tests. It is only when sand tests (or soil tests for that matter) can be shown to be more uniform than blotter tests as a matter of course, that they can be used with any confidence as a criterion for the judgement of normal sprouts. - C. W. Leggatt, Chairman

Brief Discussion by the General Chairman

Partly owing to problems of organization which have already been mentioned, and partly owing to misunderstandings, there has been some confusion in regard to the study of techniques for chalcis fly-injured seeds. The research committee recommended last year that this problem should be studied by the sub-committee on techniques for small seeds. This, of course, was not intended to prevent anyone interested from working on the same problem, but as an Association activity it could not be assigned to some other sub-committee as well. It appears, however, that some cooperators thought that it was assigned to them as an activity of their sub-committee proper and the techniques sub-committee had some difficulty coordinating all these activities in consequence.

In order to avoid similar confusion in the future and in order the better to coordinate the research activities of seed analysts, the research committee puts forward the following recommendations for discussion and adoption by the Association as a good working policy:-

Recommendation

This Association does not seek to restrict in any way the research activities of individual analysts. Nevertheless, research problems assigned to definite sub-committees should be handles by them entirely, in as far as the study of such problems as a definite Association activity is concerned. Other sub-committees may be asked to cooperate, but only as members of the sub-committee to which the problem is assigned. Individual research workers studying problems similar or parallel to one assigned to a sub-committee ought, as a matter of good will, to provide the chairman of that sub-committee with an abstract of the results of such study when it is to be presented at the same meeting as the sub-committee report. This will enable the chairman concerned properly to coordinate his report and will make for more worth while discussion of the points at issue.

It is felt that in spite of organization difficulties resulting from the war and other causes and the short Association year, some solid ground has been covered. It is particularly satisfactory to note the growth of interest in referee testing as evidenced by the increasing proportion of laboratories taking part.

Referee testing is the principal means by which uniformity between laboratories can be achieved, and it should be viewed as one of the major activities of the research committee. Care should be taken, however, to see that the samples distributed present, not only a real problem, but one which can be usefully studied by this means, relative to which it may be said that in general the work of a referee begins where the work of a special sub-committee ends. With regard to presenting a real problem, in the experience of the chairman the type of sample-sometimes used for referee work - which all agree is worthless is not satisfactory. The results obtained from such a sample are very hard to interpret by the referee and differences in interpretation of sprouts do not materially affect the opinion that the sample is worthless. Such a sample should therefore be avoided.

The work of each and every sub-committee is not only valuable but essential to the progress of our organization and should be pursued with vigour.

In conclusion, the chairman would like to acknowledge with sincere thanks the cooperation accorded by everyone who has contributed work, thought and energy to the activities which have been recorded in this report. - C. W. Leggatt, Chairman

Report of the Rules and Regulations Committee

The work of the rules and regulations committee during the past year has had to do with two things: First, consulting with the administrative officers in the formulating of rules and regulations for the administration of the United States Federal Seed Act, and second, a consideration of the revision of certain parts of the "Rules and Recommendations for Testing Seeds" as adopted by the Association of Official Seed Analysts of North America in 1937.

Federal Rules and Regulations

The rules and regulations for the Federal Seed Act were published in March 1940 as Service and Regulatory Announcement No. 156 of the Agricultural Marketing Service of the U. S. Department of Agriculture. It is apparent that these rules and regulations will have a marked effect on the methods employed in the various seed laboratories during the next few years.

History of Rules and Recommendations for Testing Seeds

In order to have the proper appreciation of our present rules for seed testing, it is desirable that we briefly review the circumstances under which they had their beginnings and how they developed.

As noted by Stone (11), seed testing had its beginning in 1869, when Frederich Nobbe established the first laboratory in Thorand, Germany. This was apparently at the suggestion of E. M. Holst, editor of an agricultural journal in Copenhagen, Denmark. Other laboratories were established as follows: Austria, 1870; Denmark, 1871, Belgium, 1875; Switzerland, Norway, and Russia, 1876; Finland, 1880; and Sweden, 1884. In 1906, 112 laboratories were operated in Europe, three in Java, one in Japan, and one in Brazil.

As related by Brown (2), a visit by E. H. Jenkins of Connecticut to Nobbe's laboratory was the beginning of interest in seed testing in the United States. A number of states took up the work and in 1896, G. H. Hicks organized seed testing as a definite line of investigation in the United States Department of Agriculture.

Seed testing work was begun in Canada about 1902. In November 1896, according to True (14), a memorial signed by a majority of the experiment station directors, was presented to the Association of American Agricultural Colleges and Experiment Stations requesting the appointment of a committee to devise a standard form of seed-testing apparatus and methods of procedure. This committee which consisted of representatives from the U. S. Department of Agriculture, Connecticut, North Carolina, Nebraska, and Ohio, formulated a tentative set of rules which were published as Circular No. 34 of the Office of Experiment Stations of the U. S. Department of Agriculture in 1897 (7). In this work, the committee was guided by replies to a circular of inquiry received from some 25 experiment stations which had engaged in seed investigations. In 1904, this circular was revised by the same committee and published under the same title and number.

On December 31, 1908, as recorded by Helyar (6), representatives of 16 states and the United States Department of Agriculture and the Canadian Department of Agriculture, met in Washington, D. C., and formed the Association of Official Seed Analysts of North America. As will be noted by the first volume of the Proceedings, small group meetings were held each fall during the years 1909 to 1913.

In November, 1914, a larger meeting was held at which time representatives

from 11 states, the United States Department of Agriculture, and the Canadian Department of Agriculture were present. Several papers were presented at this meeting. Those which had a direct bearing on rules and regulations for seed testing were:

1. The necessity for standardization methods. By E. Brown
2. Uniform methods of sampling seed. By E. D. Eddy
3. Apparatus and methods employed in making purity tests of seeds. By F. H. Hillman

Rules for Seed Testing by Association

In 1917, the first rules for seed testing as recommended by the Association of Official Seed Analysts were published in memeographed form. These consisted of a revision of "Rules and Apparatus for Seed Testing" as published in Circular No. 34 in 1904, and were prepared by E. Brown and E. D. Eddy (3). Again in 1919 and in 1921, Brown and Eddy revised these rules and they were published in mimeographed form.

In 1927, the rules were revised by E. H. Toole and F. T. Wahlen (12), adopted by the Association, and published as U. S. Department of Agriculture Circular No. 406 (12). In 1937, a committee consisting of E. H. Toole, M. T. Munn, and W. H. Wright revised the rules and they were adopted by the Association and published as "Rules and Recommendations for Testing Seeds" in the Proceedings (13) as Circular No. 480 of the U. S. Department of Agriculture (13).

Thus it will be seen that the rules and regulations under which the seed testing work has been done for the past 70 years came about in a very normal way. They were formulated to meet a specific need and have been changed and developed as the conditions under which they have been operative have demanded.

Present Needs of Rules and Regulations

It is the desire of the present committee to learn the needs of our present day methods of testing seeds and to modify the existing rules and regulations so as to best suit these needs. To accomplish this, it is evident that we should have the cooperation of all of the members of the Association and the special assistance of the research committee. In 1932, Stevens (10) made a very constructive contribution to rules for seed testing when he proposed five points for consideration. Briefly stated, these were as follows:

1. Adopt the "International Rules" method of reporting decimals.
2. Clarify meaning of "decorticated seeds".
3. Clarify disposition of empty glumes, broken pieces, etc., and of plants the seed of which would be placed in weed or crop seeds.
4. Recommendation equivalent to the "International Rules" method on beets for the handling of seeds of uneven size or otherwise of dissimilar character.
5. Amplify recommendations for time of counting sprouts.

While some of these points have been taken care of in the latest revision of the rules, there are others which need attention.

Some Points for Consideration

During the year, certain suggestions concerning the rules and regulations have been brought to the members of the committee. These have come from various sources and deal with a number of phases of seed testing. These suggested points, listed here as a means of bringing them to the attention of the members for consideration, are as follows:

Methods of sampling. Size of working sample. Methods of making germination tests - seed of newer plants and native grasses. Examination for noxious weed seeds. Purity analysis of native grasses. Clearer interpretation of inert matter. When should decorticated seeds be considered as inert matter. Attention is called to action which was taken at the last annual meeting relative to considering that chalcis-fly or nematode infested red clover and alfalfa seeds that are externally intact be considered pure seed and not inert matter, pending the adoption of a definite rule. Identification of such seeds as quack grass, wheat grasses, and wild oats when the naked caryopsis is found. Identification of such seeds as poverty weed and marsh elder, the wheat grasses, and the bluegrasses. Recommendations on the proper use of sand and soil as media for determination of normal sprouts. Tolerances. Policy for the evaluation of hard seeds in legumes.

It is apparent that the proper treatment of the above phases of the rules and regulations will require some time and some consideration on the part of the research committee. It is believed that each member of the Association should make some contribution to this work.

Special Study of Methods of Sampling Seed

Our committee conferred with the research committee relative to kinds of seed triers and methods of sampling and it was decided to arrange for an exhibit of such triers at this meeting. In May a request was sent to each laboratory asking its support in this matter.

The interest which has been aroused in this subject of sampling seeds indicates its importance and timely consideration. Attached to this report are a number of letters which have been received. It is apparent from these that some of the older forms of triers will soon be discarded for more improved types.

Recommendations

The rules and regulations committee wishes to submit the following recommendations:

1. Tolerances - Substitute for the present tolerances the provisions for tolerances for pure seed, other crop seeds, weed seeds, inert matter, germination, pure live seed, and noxious weed seeds, as given on pages 14 and 15 of Service and Regulatory Announcements No. 156 of the Agricultural Marketing Service of the U. S. Department of Agriculture. It is believed that these tolerances for inert matter will avoid a misunderstanding such as was noted on pages 4 and 5 of Vol. 13, No. 7 of the News Letter.

2. Evaluation of Hard Seeds in Legumes - Adopt the following policy which was suggested by Whitcomb (15) at the last annual meeting of the Association:

THE SUGGESTED POLICY: Based on the experimental evidence which has been submitted and giving due consideration to the various statements which have been made relative to the interpretation of the value of hard seeds, the following policy is suggested:

1. State the percentage of germination and the hard seed separately for all seeds.

2. State the germinating capacity as the percentage of germination plus the following amounts of hard seed for the respective kinds of seeds:

(1) Alfalfa, peas, beans, smooth vetch, crimson clover, and Korean lespedeza ..... all the hard seeds
(2) Red Clover ..... half the hard seeds
(3) Other leguminous seeds..... one-third the hard seeds

3. Attach to the report a concise statement relative to the behavior of the hard seeds of the various species under varying conditions.

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W. O. Whitcomb, Chairman

Report of Meeting of Seed Council of North America

The retirement of A. L. Stone from active service in Wisconsin automatically severed his relations with the Seed Council of North America insofar as our Association is concerned. For several years he was our representative on the council. At the suggestion of our secretary your president attended the meeting of the Seed Council in Chicago on December 6, 1939 at the Palmer House.

The main address of the evening was by Dr. H. K. Hayes of the Minnesota Agricultural Experiment Station on the topic "Breeding Small Seeded Legumes and Grasses - A Challenge to Seed Producers". Copies of this excellent discussion have been made available by W. L. Oswald, editor of the Seed World.

Two important motions were passed, one dealing with the appointment of a committee to help draft a uniform state seed bill and the other to study the question of noxious weed in relation to state seed laws. L. A. Moore of Illinois who was elected president, appointed two committees one on "Uniform Seed Laws" and the other on noxious weeds. C. N. McIntyre served on the first committee and your official representative to the council served on the second committee. Both committees met in Chicago, May 3 and 4 and helped to draft the tentative uniform seed bill.

W. A. Davidson called attention to one of the major functions of the council, namely, to encourage the formation of more state seed councils. At least one new state council was organized during the year, namely, the Iowa Seed and Weed Council.

The several organizations that are represented on the national council are working on problems which are all inter-related and it seems highly desirable that the Association of Official Seed Analysts maintain its membership in the council.-

R. H. Porter

THE PROGRAM

OUR RESPONSIBILITIES AS AN ASSOCIATION

Presidential Address

R. H. Porter
Iowa Agricultural College
Ames, Iowa

In appearing before you today I am conscious of the fact that close personal relationship to the problems and practices of seed analysis has existed for about 10 years, and for that reason I should be classed as a newcomer to your ranks. At the same time I have learned much as a member and officer of this association. Fortunately, most of my experiences and positions prior to affiliation with a seed laboratory were in the field of botanical teaching, research and extension, hence an opportunity was afforded to see and learn something of the basic principles on which the several phases of seed laboratory work are founded.

It is because of this earlier training and experience, membership in the Research Committee for 6 consecutive years, close working relations with the Seed Trade, and finally as an elected officer of this association that I venture to discuss before you this afternoon the problem of "Our Responsibilities as an Association." May I say at the outset that my convictions on this subject have not been achieved suddenly, but they are the result of many experiences and contacts to which I have been exposed for the past 25 years.

Seed laboratories were first established in the United States and Canada to examine seed lots for noxious weeds and to determine the relative purity and germinating power of such lots for farmers. Later it became necessary for seed laboratories to assume either directly or indirectly the responsibilities of regulating commerce in seeds by sponsoring seed legislation and by enforcing state and federal seed laws. It is reasonable to assume that the acceptance of the first responsibility entailed no serious difficulty; its value grew with the accumulation of new information as to seed identity and as to the requirements for seed germination. The history of the association shows clearly that the early workers understood many of the problems and struggled by investigation and study to solve them. Rules and regulations were adopted for the purpose of perfecting and promulgating uniform methods for seed testing.

The assumption of the second responsibility, that of regulating commerce in seeds, entailed many difficulties from the outset, difficulties which are inherent in a program of control. The Association of Official Seed Analysts apparently understood the nature of some of the problems at the outset, one of which was the need for uniform state laws. Throughout the period of its history our association has made an honest effort to promote uniform laws and uniform procedures in their enforcement.

In my efforts to understand the objectives and policies of our association I have read something of its history as well as many of the reports of Proceedings and technical papers dealing with seed technology. It seems to me that there are four principal objectives which have evolved since 1908 when our association was formed. These objectives may be listed as follows:

1. To conduct research and referee testing with a view to increasing knowledge of seeds and developing uniformity in seed testing.
2. To adopt and continually revise rules of procedure in seed testing that should aid in the development of uniform results.
3. To develop a uniform bill that would serve as a model for each state seed law to the end that seed merchandising might be properly and more easily regulated.
4. To develop an educational program and cooperate with educational agencies whose objective is that of informing farmers and seedsmen as to the importance and value of high quality seed.

As members of an association that has been in existence for over 30 years, is it not appropriate that we look critically at outselves and attempt to evaluate the extent to which our objectives have been achieved? Following that analysis should we not determine what our major responsibilities are for the immediate future and so organize our efforts that our responsibilities may in part be more completely fulfilled? Let us look for a moment at our accomplishments.

In the field of research the contributions to our knowledge have been remarkable and while much valuable information has come from other than professional seed analysts, yet in Europe and America a wealth of literature has come from those particularly concerned with seed technology. Dormancy, longevity, impermeability, pathology, morphology, physiology and germination of seeds as well as statistics and the interrelations of moisture and temperature as they affect seed viability and germination are all better understood today than they were 30 years ago. In so far as financial support would permit, seed laboratories have added equipment and adopted practices that have aided in the application of fundamental principles to the practice of seed testing. We who have come into the field of seed technology within the past 10 years have a rich reservoir of knowledge upon which to draw as a

result of the work of many investigators. It seems to me that the contributions in the field of research have been greater than in any other, for which we may well be thankful because they should lay the foundation for sound and healthy growth in the other aspects of our work.

From the standpoint of uniformity which referee testing was designed to promote, it must be apparent to all of us that we are far from a desirable goal. This problem is so important that I shall deal with it subsequently in more detail. Suffice it to say, for the present, that a fair and equitable enforcement of state and federal laws cannot be expected until more uniformity in technique and interpretation is achieved.

Adoption and revision of rules and regulations for seed testing have received considerable attention, and much progress has been made in this field of endeavor. It is expected that as more knowledge becomes available, adequate changes in the rules will be made, although I feel that a modification in point of view may be desirable as I shall bring out later.

A situation, similar to that in testing of seeds, prevails in the field of seed legislation and regulation of seed commerce. The reports that have been made in the past as well as at this meeting clearly show the difficulties to which a seedhouse is often subjected when it attempts to do business in another state. Surely there is room for vast improvement in this field.

In the field of education much progress has been made, but much more remains to be done if we are to fulfill our responsibilities in this important field of activity. It must be kept in mind that education of ourselves is just as important as education of the laymen. Further reference to this problem will be made later.

Having reviewed briefly the objectives of our association and the extent to which they have been achieved, may we turn out attention to what appear to be our immediate and long time responsibilities if seed technology is to be put on the high plane of service that it must maintain to endure.

The first and foremost responsibility is that of developing such uniform technique and interpretation of results that only those differences which are caused by natural variation and improper mixing will exert an important influence on the reports made by any seed laboratory. This goal should not be interpreted to mean a complete mechanization of seed laboratory practices to the exclusion of intelligence and scientific accuracy. As analysts, we must be over alert to the significance and value of new information, to the development of sound judgment and to the dangers which mechanical methods without intelligent understanding entail.

There are three major causes for non-uniform results in seed testing to which our laboratory has given some attention. They are (1) improper or inadequate bulking, mixing and sampling by seed houses, (2) dissimilar equipment and facilities in and methods and technique employed by seed laboratories and (3) differences in personal judgment of analysts as to what constitutes pure seed and what are normal and abnormal seedlings. As our research program in Iowa developed we recognized that one of the greatest needs was to determine and isolate each factor for separate evaluation as to the part it played in producing non-uniform results. If we have made any important contributions to seed technology, one has been the study of se several factory separately as each affects the end results. To accomplish anything in this field it has been necessary to first determine how much natural variation one might expect, and this in some cases could only be measured by developing a uniform technique which reduced the human factor to a minimum.

Data have now been accumulated which show unmistakably that differences in purity between individual bags of bluegrass seed from the same lots are often far

greater than should be expected in a uniform lot. Obviously more careful mixing must be given and a rapid and accurate method of testing different parts of a bulk lot must be available to seedhouses. This latter has not been accomplished for small seeded grasses.

Similarly studies have been made which indicate that dissimilar methods and technique employed by seed laboratories frequently account for abnormal differences. The distribution of uniform pure seed fractions of bluegrass, orchard grass, reed canary grass and red top seed to several laboratories has provided ample evidence that either light, substrate, kind of water used or temperature is responsible for the extreme differences in germination that have accrued. Inasmuch as light and source of water are the most variable factors it is believed that the use of uniform artificial light for some seeds will greatly reduce the variability of the light factor and that the use of distilled water may throw some light on the problem.

The third major cause of non-uniform results, the personal judgment factor, has received more attention than any other. It operates to a great degree in purity analyses of many grasses and in germination tests of many vegetable and field crop seeds. We have shown conclusively that the differences in purity percentages obtained by different analysts with representative samples from uniform lots of blue grass, red top, orchard grass and reed canary grass are far greater than can be accounted for on the basis of natural variation. This has been demonstrated by submitting samples that were previously tested by a uniform method of procedure whose accuracy has been adequately proven. Such results are not surprising when we consider the character of the material with which we work. In many grasses there are several degrees of development of the florets, some never produce the essential floral organs, others contain only anthers, others an undeveloped ovary while others fail to achieve much growth after fertilization. There is no doubt but that the determination of absolute purity of such material is a practical impossibility and we must adopt some empirical, arbitrary measure of purity if any degree of uniformity is ever to be achieved. Is it not reasonable to believe that uniform air pressure applied to such material is one way of standardizing procedure? For my part we have conducted so many controlled experiments with several kinds of grasses that no one can now convince us that this method is not a sound one. The method has been applied not only to several grasses but with some success to chalcis-fly infested red clover and alfalfa seed. It has been shown further that the major portion of wheat and barley kernels severely infected with species of Fusarium and largely non-viable can be removed from healthy seed. There is no reason why the principle could not be applied to delinted cotton seed for the purpose of removing seeds severely infected with the anthracnose and other organisms. The Oklahoma experiment station has used flotation of delinted seed in water to remove those seeds whose specific gravity is less than that of healthy seed. No doubt other applications of this principle of air pressure will be found not only in seed laboratories but in other situations where it is desirable to separate light and heavy weight seeds.

The value of this arbitrary method of separating immature, undeveloped, diseased and empty florets from the "pure seed" fraction has been further shown in that the pure seed obtained from a large number of sub-samples is remarkably uniform. A large number of uniform germination tests under uniform conditions using the several pure seed fractions have conclusively proven that such fractions are uniform. The results of such experiments have forced us to modify our concept of the term "pure seed" as used in seed laboratory terminology. A change is necessary if our tests are to provide a basis for evaluating seed lots for planting. For

example, the most practical evaluation is one which gives either the number of pounds of viable seed per hundred or the maximum number of plants which might be expected under optimum conditions from each pound of seed. Either method has merit and each has at least one advantage over the other. Inasmuch as all state and federal laws adhere to the use of purity and germination in labeling and because changes come slowly it would seem that for the present we should attempt to determine a figure that will most closely represent the number of pounds of viable seed per hundred. If this be accepted as sound, then we must avoid retaining in the pure seed fraction those immature, non-fertile seeds or florets which cause a decrease in germination that is disproportionate to the increase in purity when such particles are included as pure seed. To explain more clearly what is meant, may I quote directly from an article that was prepared last year for the hand book as follows: "Laboratory tests of all seeds will more nearly represent the value of seed lots if the unit weight of living and non-viable seeds in the pure seed fraction is approximately the same. Percentages of purity are based on weight, whereas percentages of germination are based on number. The most practical way in which purity and germination data can be used together is to use them to determine the number of pounds per hundred of pure live seed. This may be accomplished by the simple procedure of multiplying the per cent pure by the per cent germination and dividing the product by 100. The figure obtained is correct only when the unit weights of the living and dead seeds in the pure seed fraction are the same. The retention of light weight, immature and badly shriveled seeds (most of which are non-viable) with the heavy seeds increases the difficulty of determining the number of pounds per hundred of pure live seed. The modified method of determining purity of small seeded grasses commonly gives a purity lower than may be obtained by the official method but the germination is usually higher and the product of the two values is greater by the modified than by the official method. The results obtained to date definitely show that a much higher degree of uniformity may be obtained in both purity analyses and germination tests by the use of this modified method than is possible by the official method of procedure. In the development of standards for measuring seed quality or for the control of an industry uniform procedures are of primary importance, hence theories and concepts must be modified in their application to practice without the sacrifice of sound scientific principles. The proposed method is believed to have a more scientific and sound basis than the old official method, in that errors of personal judgment are largely eliminated."

Interpretation of normal sprouts in alfalfa, sweet clover and many other seeds is another major source of wide differences. Experiments with pure seed fractions of both alfalfa and sweet clover seed in our laboratory have shown that when germination tests of many sub-samples are made under uniform conditions the results are uniform; yet when the same are tested in different laboratories the results are often widely divergent. Similarly, pure seed fractions obtained from each of several subsamples of sweet clover seed by as many laboratories give non-uniform results when tested by the respective laboratories for viability but when the same are tested in one laboratory under uniform conditions the results are uniform. These experiments clearly show the effect of personal opinion on the interpretation of normal and abnormal seedlings and they suggest that somewhere a common basis for measurement must be found. Is not our responsibility in this field clear to us? When reports from laboratories indicate much greater differences than actually exist, we must find a common ground for compromise.

In our research for a basis of compromise may I suggest that we seek to see

both the laboratory and the practical sides of this problem. For the past 20 years one of my responsibilities has been to interpret and apply the results of research directly to farm problems and practices. There is a large field between the research laboratory and the farm which often is overlooked, and I know from personal experience that one's point of view is modified to the extent that he has close association with the problems of closely related fields. Let me illustrate what I mean. In our laboratory we have made tests of sweet clover and alfalfa seed that germinated from 65 to 75%. To many farmers 75% seems like a low test because they think in terms of corn germination of 95 to 99%. Yet excellent stands of both sweet clover and alfalfa have repeatedly been obtained with seed of the quality referred to. The reason is obvious. For example, a pound of pure sweet clover seed contains 258,560 seeds which if evenly distributed on an acre of ground would place nearly 6 seeds on each square foot of land. Normal rates of seeding are 8 to 15 pounds per acre and if we take 10 pounds as an average, there could be between 50 and 60 seeds sown on each square foot of land which is far more than is needed if 50% of the seeds germinate and if reasonable attention to seed bed preparation is given. A difference of 10 or 15% in laboratory germination by two laboratories on the same lot of seed will not mean the difference between success and failure in obtaining a stand. This difference of 10 or 15% in normal sprouts, which about represents the average extremes as reported by seed laboratories, occurs in the area of questionable seedlings and the emphasis placed in that area is out of all proportion to the practical effect it has on field stands, on the movement of such seed in commerce or on the welfare of many people whose livelihood is represented in the transactions that have taken place. What I mean to say is that we as analysts have a responsibility to adjust these comparatively small differences which can only be accomplished as we cease to over estimate their importance.

A second suggestion is that we approach the problem of interpreting normal seedlings in a slightly different way than has been emphasized in recent years. It is that we class seedlings with normal structures as normal until we can prove them abnormal. Field trials can and have been over emphasized in measuring normal seedlings because environment is so variable within a season and from one season to another. We must have a standard laboratory measure and when all factors and angles are considered, it appears that the maximum number of normal seedlings produced under known optimum conditions is the safest criterion. To help clarify these suggestions the following definition is proposed: "A seed will be considered to have germinated when it has developed those structures which are commonly recognized in different varieties, species or families of plants as essential in normal seedlings. Broken, malformed or other seedlings which are known to be incapable of producing plants in laboratory sand or soil under favorable conditions will be considered as abnormal and not to have germinated." We believe that a laboratory method based on this definition of germination is in process of development, that it will give us far more uniformity than we have at present and that if accepted it will result in great benefit to the entire seed industry. As new information is accumulated relative to abnormal seedlings, such could be utilized in laboratory tests. It is obvious, of course, that when large seeds such as corn, lima and garden beans, peas, watermelons and others are involved in tests, a considerable number of questionable seedlings may be of greater importance than with clovers, alfalfa and small seeded grasses. Yet standard emergence tests should be possible as a guide to the value of large seeds.

As an aid to the development of uniformity it would be well if this association could designate three members of the research committee as a subcommittee to work with a representative of the United States Department of Agriculture for the purpose of developing a set of standard tests that could be made by the several state laboratories. These tests could be made with the assistance and supervision of the representative from the Department of Agriculture who should visit each laboratory at the time the readings are made. Out of such an effort could come a more uniform set of procedures and interpretations that should be acceptable to all. Many of us in state laboratories would have to give up some of our real or imagined "state rights" and the Federal Department of Agriculture would have to be truly cooperative, not dictatorial, but serve as a coordinating agency. All of us would of necessity have to become less individualistic, more cooperative and realize that our goal must be that of promoting the general welfare which in the last analysis is far more important than the welfare of one group or one state. It is my belief that our association must shoulder the responsibility for promoting such a cooperative movement.

In the field of seed legislation our responsibility seems clear. A great lack of uniformity exists in our state laws as to kinds of weeds listed as noxious and tolerances allowed in the enforcement of laws. Other irregularities exist, all of which must be adjusted or corrected to the end that seed merchandizing may become less expensive in cost and less hazardous. Our association has an opportunity to discuss and gives its support to a proposed uniform seed bill which has already come to your attention. Let us hope that we may be practical as well as scientific in our efforts to solve this difficult problem.

In the field of education we have a great responsibility in several directions. First, there is the farmer who harvests and plants the seed that we test. We need to impress upon him the folly of planting uncleaned seed that he or his neighbor produced. He needs more information about how to interpret our reports in terms of field planting. He wants information on seed longevity, dormancy, impermeability and the nature and importance of organisms that occur on seeds, he needs increased cleaning facilities, and finally he wants to know when and under what circumstances seed disinfectants should be used. The agencies that are available for the discharge of this responsibility are numerous. State extension organizations, 4-H clubs, the radio and press should be much more extensively used.

The addition to providing farmers with more information about the importance and value of good seed we must impress upon them by every means at our disposal their responsibility for good farming which included weed control. We hold seedsmen responsible for selling good seed and the trade has responded by investing millions of dollars in equipment that does almost unbelievable things in cleaning up foul lots of seed. To be consistent we in many states must remove the farmer exemption clause from our laws, be more diligent about our weed laws, help develop better educational programs for weed control, devise improved methods of control, in short we must give our support to a program that will make farmers assume more personal responsibility for the control of weeds.

Secondly, the seed inspector needs our help in seed identification because the better informed he is about weed and crop seeds the more efficiently he can perform his duties which may often lessen the work of the analyst. Seed lots that are clearly mislabeled can be withheld from sale by those inspectors who are well versed in seed identification. Seed inspectors can also be of great assistance to seed merchants if they are well informed about tolerances and methods of testing. Commissioners of agriculture and members of legislative committees also welcome and

need our help in the technical aspects of seed legislation and regulation. To them all we owe a great responsibility.

One of our greatest responsibilities which is coming to be more generally recognized is to the seed trade. Within the past 5 years it has been my privilege to attend a number of meetings of both state and national seed associations and to speak to them on several subjects. In addition I have visited a number of large seed houses where I have learned much about the problems of seed cleaning, mixing, bagging and merchandizing. The thing that I have been most impressed by is the sincerity of seedsmen in their desire for the closest possible relation to us as individuals and to our association. They want to be able to come to us with problems, they want to understand our point of view, our methods and the reasons for them. At the same time they want to present their own point of view without being misunderstood or placed under suspicion. Naturally and rightly, they hope for greater uniformity in testing methods, yet they are equally anxious to profit by any suggestions we can make about mixing more uniformly and sampling more accurately. They would like to see more uniformity in state seed laws and regulations. As tax payers they are as much entitled to our interest and study as are farmers or other laymen. Finally, seedsmen want our help in training analysts for routine testing in their warehouses. They expect to pay for this service, but they would like to have the opportunity of sending their analysts to us for short courses so that they may learn more about our methods of testing and our evaluation of results. It is my conviction that by such cooperation we may come to understand each other better. There may be those who fear that such a service may lessen the need for an official laboratory in a state, but we have found that our service is increased rather than decreased.

To commercial analysts we have a special responsibility. Many of them have spent years in preparation for analytical work, they have had broad experiences and they have seen the problems from both the laboratory and the commercial angle. in their organization they have gone farther than we in that they have junior and senior membership. They have a right to know why we adopt certain rules, why we follow certain practices and most of all they need our sympathetic cooperation and understanding. Their suggestions and observations should be carefully considered by our association and incorporated in our rules and regulations whenever advisable. I have found commercial analysts most friendly, fair and open minded, and I hope the time will come when we may have one Association of Seed Technologists, each member of which is engaged in the common enterprise of evaluating seeds in a uniform, standardized and scientific manner.

In conclusion it seems appropriate to remind ourselves that the responsibilities of our association are likewise the responsibilities of the member laboratories and of the several analysts in each member laboratory. Those of us who are charged with the administration of the several phases of seed laboratory work and with the supervision and training of analysts who are preparing themselves for a profession, have an added responsibility. We must try to envisage our field of activity in a broad and comprehensive manner, we must understand and appreciate the importance of those who carry out the daily routine of laboratory procedures and give them more opportunities for personal growth and development, we must be truly cooperative with all related agencies, we must be confident of our methods and firm in our decisions, but most important of all we must keep our minds open and our judgments as fair as possible. If we can work with that kind of a spirit, we shall be able to help build a better service and thus in a small way contribute to the happiness and welfare of millions of people.

Reactions to the Federal Seed Act and Some Observations for the Improvement of Seed Conditions in the South

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Southern Seedsmen's Association,
Darlington, Alabama

My observations and a limited investigation reveal that seedsmen as a whole welcome the Federal Seed Act and believe that it is going to be beneficial to themselves, as well as to farmers, truckers, and others who use seed.

We seedsmen must admit, however, our lack of knowledge of system and of equipment to enable us to properly comply with the Act this past spring. The larger part of our stocks had been bought without grower's declarations or other data necessary to enable us to properly comply with the law, which, of course, went into effect on field and imported vegetable seed on February 5. This was at the peak of seed movement in the South. Ignorance of the law and a lack of time in which to familiarize themselves with it, prevented some from making much effort to comply. The larger and better informed seedsmen made more of an effort to comply. As time goes on, and a better understanding of the requirements is gained, I look to see compliance become very general. Most of the complaint against the Act so far has not come from real seedsmen, I am confident, but from certain dealers who contribute little to the improvement of the industry, and who are merely merchandisers - often of the cheapest seed stocks available, which are, of course, usually inferior and not capable of meeting the requirements of the Federal Seed Act. The quicker the practices of this unscrupulous group can be controlled, the better it will be for the industry.

To a large extent, the successful enforcement of the Federal Seed Act and its regulations, and the results which are desired from them, depend on state seed laws, I think. It is going to be necessary for existing state laws to be amended to dovetail with the Federal Act, if the program is going to attain its fullest success. Many of these laws vary widely at present, of course. Most state officials that I know about were unable to change their seed law and enforcement practices to conform to the Federal Law in time to do much on a cooperative basis with Federal authorities this spring. Other states planned to attempt to ammend or to form and pass new seed laws. In Louisiana, the Louisiana Seed Council and the Louisiana Seed Dealers' Association would have made a vigorous effort to have the proposed new uniform state seed law enacted this year by their legislature had the uniform state seed law been in final form. All action has been deferred, however, until the next session of the Louisiana State Legislature, due to the Legislative Committee of the American Seed Trade Association and Federal enforcement officials not having completed this work. In the case of Georgia, which is still without a seed law, it was deemed advisable to wait until the uniform state seed law is prepared and then make an effort to get it adopted. The importance and desirability of uniform state seed laws is going to be stressed at the annual convention of the Southern Seedsmen's Association which begins in Montgomery tomorrow, and it is hoped that with the encouragement seedsmen will get from this and other regional and national conventions, that there will be a demand for uniform state seed laws in the South, and in other states, for it will certainly be much easier and more practical for interstate business to be conducted if we have uniform regulations.

With the new forms and other information that have been issued, seedsmen will be from now on in much better position to make a systematic attempt to comply with the Federal Seed Act. The assistance and cooperation from Federal enforcement officials has been all that seedsmen could ask. They have taken a very common sense attitude in the enforcement of the Act, and are freely helping educate seedsmen to what is expected of them. We are satisfied that the law and its regulations have been made just as practical as possible and that should time and experience show imperfections, we have confidence in Dr. C. W. Kitchen, Chief of the Agricultural Marketing Service, and Mr. W. A. Davidson, Chief Enforcement Officer of the Act, to take steps to remedy such situations. Also, we believe the officials will want to call seedsmen into their councils so as to have the benefit of their viewpoints. With continued help, we feel that seedsmen should get into the swing of compliance for the fall season and that enforcement officers will then begin to check for the careless or wilful violators of the law. Had it been insisted upon this past spring that seedsmen comply in every way with the law, it is likely that they would now find themselves in jail or have been fined beyond their ability to pay. I, therefore, emphasize that the seed industry is grateful for the time and effort which have been given them to make study and preparation in order to try to live up to what is expected of them.

It should be of interest for our Analysts to give consideration as to how our seed dealers have received their education. I wonder how many Analysts were trained by having a well-rounded course in seed laboratory operations. I would like to ask whether any of you know a seedsman who has had an opportunity to take a well-rounded agricultural course in which was included work along seed lines as his major subject. Some seedsmen have agricultural training from our colleges, but as far as I know, no college in the South and but few in the United States offer any worthwhile training in seed as a major study. Recently in one of the Southern states, a meeting was held that included the Dean of the College of Agriculture, the Director of Extension, the Extension Agronomist, the Chief of certification and the Supervisor of Vocational Agriculture. An ordinary report from one of our state seed laboratories was passed around and each personally was asked whether they could explain in full the information carried on the analysis. The test in question was the same as is sent to any farmer who sends in a few seed to the state laboratory. Not one of these officials could give a satisfactory explanation of the different figures that related to germination. These men were further asked to name the noxious weeds listed in the State Law and not one could do so. The third question asked whether or not these men had ever seen a copy of their state seed law and all admitted that they had not. The Supervisor of Vocational Agriculture present was an ex-principal of an agricultural school and he further stated that he had never given thought to the desirability of having students of vocational agriculture study about noxious weeds and related subjects, which, of course, would mean much to them later as county agents, teachers, farmers, seedsmen, or in doing almost any kind of agricultural work.

Since the meeting referred to, this supervisor has developed plans for studying seed in schools of his state and is arranging a series of seed judging and weed seed identification contests to be held throughout the state this summer.

The seedsmen of the South, in my opinion, are anxious to improve the quality of the seed they sell. They believe that the new Federal Seed Act and uniform seed laws or the standardization of their present laws, coupled with research in our colleges and education along seed lines in high schools and colleges will bring about revolutionary improvements in the quality of the seed used in the South.

we hope that analysts and enforcement officials will join with seedsmen in an effort to bring about seed education in the South. One of my recommendations to the Southern Seedsmen's Convention will be "That we establish a strong Educational Committee, two primary objectives of which will be:

"(a) The establishment of Seed Councils in every state embraced by this Association, and

"(b) The enlistment of all Agricultural Colleges in these states in providing training in seed reclaaning, seed treating, seed scarifying, storage to preserve viability, and related practices; and wherever practical, in offering seed analytical courses."

I believe that State Seed Councils with all agricultural agencies cooperating can and will eventually realize the educational objectives that we all recognize as being so necessary.

May I repeat and emphasize the necessity for seed research work in our colleges? In addition, there should be studies on seed reclaaning, seed treating, seed scarifying, storage to preserve viability and similar practices as listed in the recommendations quoted above. Furthermore, I think the colleges and extension services should keep in contact with seed growers in order to teach and encourage them to produce seed that are true to name, free from disease and free from noxious weeds. In short, more technical knowledge about seed is needed by most agricultural officials, seedsmen and farmers covering every step in seed production, processing and distribution.

There is another thing which, in my mind, can be done for the improvement of seed conditions in the South, and the country. Analysts, seed law administrators and seedsmen can all play an important part in bringing it to pass, but the extension services in the various states can do far more. This is to teach farmers, and especially our Southern farmers, to get away from their bargain-hunting tendencies, and be willing to pay seedsmen a price for whatever they may be purchasing that will enable the dealer to furnish a decent grade. Thus far, most state seed laws do not establish minimum standards either for purity or germination, and the rank and file of farmers still purchase on a price basis and pay little regard to the quality which the labeling reflects.

In the last analysis, the largest amount of dockage that has gone on in farm seeds is on transactions between farmers and so long as farmers are poorly regulated, or not regulated at all, other farmers are going to buy from them because the price is cheap. We all know that but very few farmers have any kind of cleaning equipment and that most of them know and do little about testing and buying seed. You analysts realize that in grasses and clovers, it is the farmer who is primarily responsible for the amount of weed seed in the seed than the reclaaner or seedsman buys. One of the greatest services, I think, which seed law officials can render is to bring about laws and the enforcement of laws which will compel farmers to clean on their own fields and rid them of noxious weeds. I understand that Michigan is perhaps the only state at present that has such a law.

I would like to compliment some of the state analysts who have invited the principal seedsmen in their states or territories to come in for round-table discussions of seedsmen regulations, or new rules and regulations which may be issued by us. It has been a pleasure to attend two such meetings of officials and seedsmen during the past twelve months - one in Montgomery, Alabama, in April 1, and the other in Little Rock, Arkansas, just August 31. I feel that these conferences can be profitable and much good can be done in such conferences. It is quite in order for the state analysts or enforcement officers to tell the seedsmen what

they have in mind and what they seek to accomplish. Then, I feel that it is highly desirable to secure the opinions of seedsmen as to whether such regulations are free from possible business difficulties and are sound and workable. Seedsmen appreciate such consideration and cooperation from officials, and I believe that out of these conferences come a better understanding, more practical regulations and a stronger desire on the part of seedsmen to comply with the laws which govern them.

Increasing and Renewing Seed Stocks in One-Variety Cotton Communities

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One of the most serious problems in connection with the improvement of the quality of the cotton crop is the great number of varieties planted in the United States. A survey in Georgia in 1926 showed more than 300 names of varieties and strains of cotton. The total number in the entire cotton belt was probably several times this figure. With this great multiplicity of varieties to become cross-pollinated in neighboring fields, and the seed mixed at custom gins, the different kinds soon become hoplessly mongrelized so that no dependence can be placed on either yield or quality.

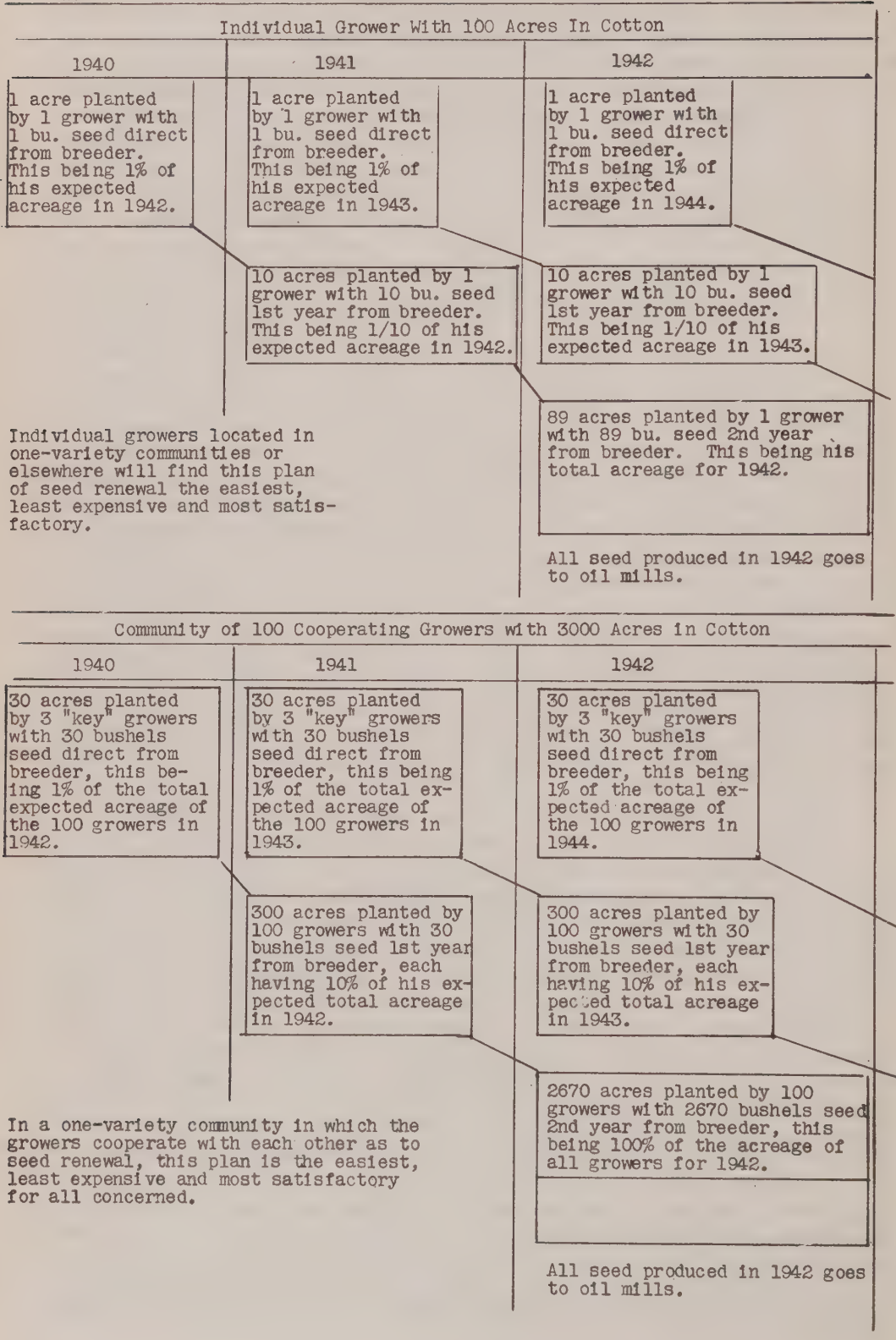
The one-variety community plan of cotton production now being carried on in all the principal cotton producing states by the Extension Service and State Experiment Stations cooperating with the Bureau of Plant Industry, U.S.D.A., is a plan of standardized production of cotton and is regarded as the most practical and effective way to bring about permanent improvements in production and quality of our cotton, and to safeguard the prestige of American cottin in the markets of the world.

A one-variety cotton community is described as a group of growers in a gin district, a county, or larger area, who have organized for the purpose of standardizing on and maintaining the purity of a superior variety of cotton that is suited to the local conditions and meets the quality demands of the market for both lint and seed, and to promote the use of all other production practices that will tend to economically increase yield per acre and improve quality, thereby making it possible for the members to realize the largest possible net income from their cotton crop.

Selection of the variety to be grown is based upon the results of tests by the State Experiment Stations or the United States Department of Agriculture. The seed stocks are secured from reputable private breeders or the Experiment Stations and multiplied in the community. There is no crossing of different varieties in the fields, no mixing of the seed at the gins and good planting seed is made available to all of the growers in the community at a price which all the farmers can afford to pay.

The theoretical plan of seed renewal is for each grower to secure from the breeder enough seed annually to plant 1/100 of his acreage. On the basis of a 100-acre cotton crop this would mean purchasing enough seed yearly to plant one acre. The seed from this acre would in turn plant ten acres the second year and the seed from the ten acres in turn plant 100 acres the third year. By this plan,

The 1-10-100 Per Cent Seed Renewal Plan for One-Variety Cotton Communities


Individual Grower With 100 Acres In Cotton
1940
1941
1942
1 acre planted by 1 grower with 1 bu. seed direct from breeder. This being 1% of his expected acreage in 1942.
1 acre planted by 1 grower with 1 bu. seed direct from breeder. This being 1% of his expected acreage in 1943.
1 acre planted by 1 grower with 1 bu. seed direct from breeder. This being 1% of his expected acreage in 1944.
10 acres planted by 1 grower with 10 bu. seed 1st year from breeder. This being 1/10 of his expected acreage in 1942.
10 acres planted by 1 grower with 10 bu. seed 1st year from breeder. This being 1/10 of his expected acreage in 1943.
89 acres planted by 1 grower with 89 bu. seed 2nd year from breeder. This being his total acreage for 1942.
Individual growers located in one-variety communities or elsewhere will find this plan of seed renewal the easiest, least expensive and most satisfactory.
All seed produced in 1942 goes to oil mills.
Community of 100 Cooperating Growers with 3000 Acres in Cotton
1940
1941
1942
30 acres planted by 3 "key" growers with 30 bushels seed direct from breeder, this being 1% of the total expected acreage of the 100 growers in 1942.
30 acres planted by 3 "key" growers with 30 bushels seed direct from breeder, this being 1% of the total expected acreage of the 100 growers in 1943.
30 acres planted by 3 "key" growers with 30 bushels seed direct from breeder, this being 1% of the total expected acreage of the 100 growers in 1944.
300 acres planted by 100 growers with 30 bushels seed 1st year from breeder, each having 10% of his expected total acreage in 1942.
300 acres planted by 100 growers with 30 bushels seed 1st year from breeder, each having 10% of his expected total acreage in 1943.
2670 acres planted by 100 growers with 2670 bushels seed 2nd year from breeder, this being 100% of the acreage of all growers for 1942.
In a one-variety community in which the growers cooperate with each other as to seed renewal, this plan is the easiest, least expensive and most satisfactory for all concerned.
All seed produced in 1942 goes to oil mills.

the extra cost of seed would amount to only two or three cents per acre annually for the third year and thereafter. Seed from the 100 acres would be sold to oil mills as the seed renewal plan would provide fresh seed each year for this acreage.

In actual practice several variations from this plan are followed. In some cases the ginner or warehouseman places the desired quantity of breeder seed with selected farmers who plant their entire acreage in the breeder seed. The farmer is given a slight premium, sufficient to take care of the extra cost of seed purchased, for all seed produced beyond his own needs. This seed is then recleaned, treated with Ceresan dust and sold or swapped to other growers in the community on the basis of one and one-half or two bushels of mixed or mongrelized seed for one bushel of the pure seed. This plan has worked very successfully when the ginner or warehouseman is the right kind of man.

Another variation is to place the breeder seed with selected "key" growers in the community for increase and these "key" growers agree to make the seed produced on the increase fields available to other growers in the community at only a few cents bushel over oil mill prices.

All communities are urged to make provision for testing the germination of all planting seed. In all cases the amount of seed secured from the breeders annually should, when multiplied, be sufficient to plant the entire acreage in the community within two years and have some surplus seed to be used in case replanting is necessary or to offer to neighboring communities. The growing of seed as a money making scheme is discouraged in all cases, however.

In 1939, Georgia had 183 active one-variety cotton communities, located in 78 counties, with one-variety cotton representing 17% of the total acreage for the State, and 19.9% of the total crop of the State. The average yield per acre in the one-variety communities was 277 pounds linit, as compared with a State average of 224 pounds.

Diagram showing the seed renewal plans for individual grower with 100 acres in cotton and another for "key" growers in community of 100 cooperating growers with 3000 acres in cotton are attached.

The Quality of Seed Farmers Grow and Plant, - A Seeder Survey[1]

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Pages of printed data from official inspection samples reveal the quality of clover and grass seed farmers can purchase upon the open market in any area. The quality of the seed stocks farmers grow on their own premises and then pass thru their grass seeders is apparently unknown. Farmers have been accused of aggravating the weed control problem by using uncleaned seed, by farm to farm vending, over-the-fence sales and law evasion.

With the idea of finding an answer to these questions fully 1000 New York farms were visited and where it was learned that the occupant of the farm had grown alfalfa or clover seed and was seeding it back on the land, permission was asked to draw a sample. At the same time queries were made regarding the original source of the seed, its production, cleaning and other pertinent facts. In every

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[1]Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 415.

case where the owner wished a complete report on his seed stock it was sent to him. On all other farms where samples were not taken the farmer was not growing legumes or was buying his seed from a dealer.

A summary of the results of the analyses and tests of these samples is given in Table 1.

Table 1. - Summarized results of findings on 100 stocks of seed which farmers had grown and were using in their own grass seeders in the spring of 1940.

	Red clover	Sweet clover	Alfalfa	Mixtures
Number samples secured	54	19	13	14
Stocks tested previous to visit	17	9	5	2
Maximum purity percentage	99.76	99.86	99.75	99.65
Mean purity percentage	96.99	97.14	95.88	93.32
Minimum purity percentage	85.05	67.80	82.05	70.30
Maximum weed percentage	5.15	32.10	5.50	5.20
Mean weed percentage	.90	2.42	1.02	1.29
Minimum weed percentage	trace	trace	none	.10
Maximum germination	94/3	92/3	87/3	Red clover 79/4
Mean germination	85/9	67/8	65/18 Mean	sw. clover 28/21
				Alfalfa 60/18
Minimum germination	63/8	33/22	47/8	Timothy 72
No. of stocks unfit	14	12	4	9
No. of stocks objectionable	8	3	1	1
No. of stocks with noxious weeds	18	12	2	9
Maximum No. weeds present	11	14	9	14
Mean No. weeds present	5	6	4.3	7.1
Minimum No. weeds present	1	1	1	4
No. of stocks recleaned	48	17	10	11
No. of samples that could be decidedly improved by additional recleaning	29	2	7	11
Weeds most prevalent	Wild carrot	N.B. catchfly	Wild carrot	Yellow rocket
Weed 2nd most prevalent	Green bristle-brass	Green bristle-grass		Buckhorn plantain
No. of stocks for sale	19	9	7	1
No. of violations	1	3	2	0

The percentage of seed stocks regarded as unfit because of the excessive weed seed content was surprisingly high, particularly for the home-grown sweet clover seed. In the case of the sweet clover, 12 of the 19 stocks samples were unfit for seed largely because of noxious weed seeds, principally Curly dock (Rumex crispus). Also, it will be noted that the germination of the sweet clover was rather low. Investigation indicated that this loss of viability was due to inability to clean, dry and store the seed properly after it was harvested with a combine, especially if the weather was unfavorable or the land foul with weeds. Other stocks were regarded as objectionable because of some other characteristic. Some were seemingly very clean and acceptable because they had been harvested from clean fields.

The results of this survey show that 29 of the 54 stocks red clover seed could have been decidedly improved by recleaning although, according to the owner's statements 48 of these stocks had been recleaned. Apparently the mills used were not adapted to this type of cleaning. Essentially the same situation existed for other kinds of seed.

Certain weed seeds were especially abundant and typical of each farm or area. In no one case did the total number of different kinds of weed seeds exceed 14.

It was found that unless a survey is made rather early the results will be influenced by the fact that seed buyers come into seed producing regions soon after harvest, buy up the best lots, tend to set the price on the remainder, and then

leave behind the lower quality stocks which are often dumped onto the market even tho legally labeled. The commercial seed cleaners who operate in a vicinity seem unable to adequately clean these stocks with the mills they have and the large seedhouses often refuse during the rush season to contaminate their intricate mills with these small and foul seed stocks.

As regards compliance with the state seed control law the survey revealed that 23 out of 100 farmers who had seed for use had secured tests from the seed testing laboratory. Further, as regards law compliance, out of the 130 definite cases where samples were taken only 6 were possible violations yet involved only 3 farmers. In each case the buyer of the seed had induced the owner to sell part of the seed stock to him and had entered the transaction with full knowledge of the facts. The seemingly wide spread belief that farmers are flagrant seed law violators was not substantiated in this survey.

Finally, this whole project of seeder-box surveys which naturally varies from season to season and area to area brings up the question of the responsibility of the seed testing laboratory in this situation. The question remains as to whether or not it is to the best interests of agriculture for the laboratory to make analyses and tests either free or for a fee of these unfit seed stocks simply so that they can be legally sold. Does not testing of unfit seed and the sending out of reports lead to harmful seed sales even tho they are legal? Would it not be better to refuse to test such seed or at least issue a report which could not be used to facilitate a sale except to a seed dealer?

Tested seed is in many cases accepted without serious question as tho the testing process enhanced its value or had given it a better status. These are all questions in which analysts should be concerned.

An Experiment in Mixing and Sampling Kentucky Bluegrass

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This preliminary experiment was started in November, 1939, and completed in May, 1940. Its purpose is to show the effectiveness of blending seeds in bulk on warehouse floors. A comparison is shown between purity analyses of samples from a bulk of bluegrass seed blended once and corresponding samples for the same seed after being blended the second time.

About 30,000 pounds of bluegrass seed were brought from the cleaner and dumped on the warehouse floor. Four men using large shovels blended this lot by shoveling from the original bulk to another part of the floor forming a second bulk. These men worked from the end of the original bulk, throwing the seed so as to cover the entire area to be occupied by the second bulk, thus spreading and blending the seed.

During the above described operation, the foreman was continually making weight per bushel tests from different parts of the bulk. After the first blending he decided that these tests were not sufficiently uniform to meet the standards of the company and ordered a second blending.

From this bulk, representing the first blend, the warehouseman took four samples, the first from near the floor, the second about one-half the distance between the floor and top of bulk, the third about three-fourths the distance between the floor and top of bulk, and the fourth from the top of bulk.

In addition to this a standard bluegrass bag was filled, sewed, labelled, and otherwise prepared exactly as it would have been prepared for sale.

In filling these bags a special seed scoop, holding about 25 pounds of blue-grass seed was used. The scoop is held very close to the bag when emptied, so the seed does not fall more than 20 inches. This is to prevent the stratifying of light and heavy seed.

From the next bulk, representing the second blend, corresponding samples were taken, and a bag was prepared in the same way. These samples and bags were removed to the Seed Laboratory and the experiment was continued there.

Four analysts participated in the purity analyses. Two blowers, the Kentucky Blower and the Iowa Airblast, and two mixers, Kny-Scheerer and Boerner, were used. Check tests were made and samples showing more than the allowable variation were retested.

Shovel Samples. Figure 1.

		1st Blend	2nd Blend
		%	%
Shovel sample at floor	1	74.40	77.29
" " 1/2 up pile	2	79.13	78.41
" " 3/4 up pile	3	81.78	78.28
" " at top of pile	4	77.80	78.48
Average	A	78.27	78.11
Variation	V	7.38	1.19

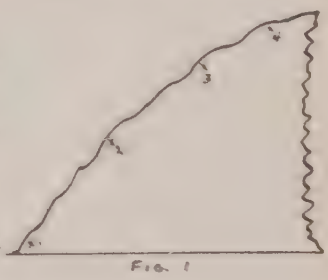

FIG. 1

These four samples were taken with shovel by warehouseman at point indicated in Figure 1. Each sample was stirred with a small stick, a smaller sample taken from it and delivered to Seed Laboratory.

Surface Samples. Figure 2.

		1st Blend	2nd Blend
		%	%
Hand sample top of bag	5	75.56	77.11
Small tryer, near bottom	6	79.04	75.94
" " " middle	7	77.16	81.57
" " " top of bag	8	79.64	79.49
Average	A	77.86	78.55
Variation	V	4.08	5.63

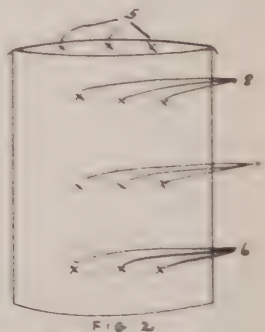

FIG 2.

No. 5 taken from points indicated in Figure 2 on top surface of open bag. Nos. 6, 7, and 8 taken with small tryer from points indicated in Figure 2.

Diagonal Samples. Figure 3.

		1st Blend	2nd Blend
		%	%
From lower corner 3 inch	9	80.12	78.78
" " " 6 "	10	77.31	79.76
" " " 12 "	11	79.30	79.40
" " " 18 "	12	77.41	76.41
" " " 24 "	13	78.70	80.10
" " " 30 "	14	78.74	76.42
" " " 36 "	15	81.23	78.36
Top of bag	16	80.32	77.65
Average	A	79.10	78.61
Variation	V	4.02	3.69

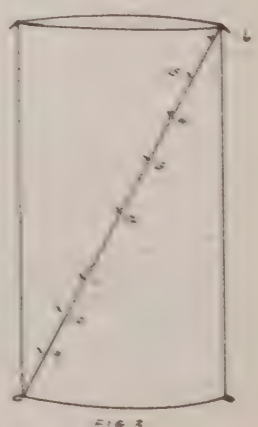

FIG 3

These samples were taken along a diagonal line from lower left corner through center to upper right corner of bag. A large grain sampler 40 inches long and 1-1/8 inch inside diameter was used. All openings except the one nearest point were closed so that samples could be taken from exact location in bag. Distances are indicated along diagonal and do not correspond to vertical distances indicated in other figures.

Vertical Samples. Figure 4.

		1st Blend %	2nd Blend %
From bottom 6 inch of bag	17	80.20	78.16
" " 12 " " "	18	80.10	76.80
" " 18 " " "	19	79.63	79.00
" " 24 " " "	20	76.38	78.00
" " 30 " " "	21	76.40	77.85
Top of bag	22	78.29	76.36
Average	A	78.50	77.67
Variation	V	3.82	2.64

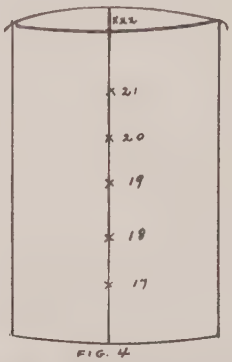

FIG. 4

These samples were taken along a vertical line through the exact center of bag. The large grain sampler described above was used.

"Levels" Samples. Figures 5" and 5B.

		1st Blend %	2nd Blend %
6 inch level a	23	75.80	79.75
" " " b	24	76.66	80.92
" " " c	25	79.92	79.71
" " " d	26	77.51	77.14
" " " (center) e	27	76.82	76.36
12 " " a	28	79.91	80.82
" " " b	29	78.96	78.59
" " " c	30	78.18	78.74
" " " d	31	80.38	79.64
" " " (center) e	32	80.50	80.31
18 " " a	33	78.52	77.65
" " " b	34	78.88	80.54
" " " c	35	80.01	79.16
" " " d	36	79.60	80.16
" " " (center) e	37	80.07	79.02
24 " " a	38	76.80	78.06
" " " b	39	78.89	78.77
" " " c	40	80.81	79.77
" " " d	41	77.27	78.73
" " " (center) e	42	77.74	77.44
30 " " a	43	78.21	81.60
" " " b	44	79.98	80.42
" " " c	45	79.70	81.19
" " " d	46	75.72	79.20
" " " (center) e	47	79.67	78.13
Top level a	48	78.25	78.08
" " b	49	78.95	80.57
" " c	50	80.45	79.62
" " d	51	79.31	78.28
" " (center) e	52	81.33	77.38
Average	A	78.82	79.19
Variation	V	5.53	5.24

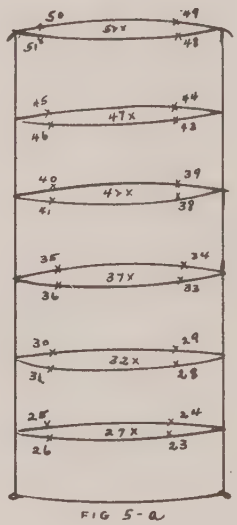

FIG 5-a

FIG 5-b

These samples are taken from 5 corresponding points on each of six levels in the bag as indicated in figures 5A and 5B. Large grain sampler used.

"Horizontal" Samples. Figures 6A and 6B.

		1st Blend	2nd Blend
		%	%
3" a	53	80.61	78.02
" b	54	78.31	78.97
" (center) c	55	79.27	77.16
" d	56	77.77	77.91
" e	57	78.45	80.21
6" a	58	75.62	79.87
" b	59	80.71	78.16
" (center) c	60	80.68	79.49
" d	61	74.34	77.82
" e	62	79.43	78.83
12" a	63	78.88	78.78
" b	64	79.20	78.25
" (center) c	65	78.71	79.72
" d	66	77.03	78.73
" e	67	78.66	79.30
18" a	68	80.08	78.98
" b	69	77.01	81.10
" (center) c	70	76.58	77.88
" d	71	79.41	77.80
" e	72	78.99	77.25
24" a	73	76.98	77.13
" b	74	77.50	78.31
" (center) c	75	78.39	78.47
" d	76	80.98	77.00
" e	77	80.24	81.02
30" a	78	77.50	77.44
" b	79	78.79	78.59
" (center) c	80	78.81	77.64
" d	81	79.03	78.77
" e	82	76.41	78.47
Top a	83	79.47	79.07
" b	84	80.00	80.44
" (center) c	85	78.25	78.33
" d	86	79.20	78.16
" e	87	77.42	78.01
Average	A	78.53	78.60
Variation	V	6.64	4.10

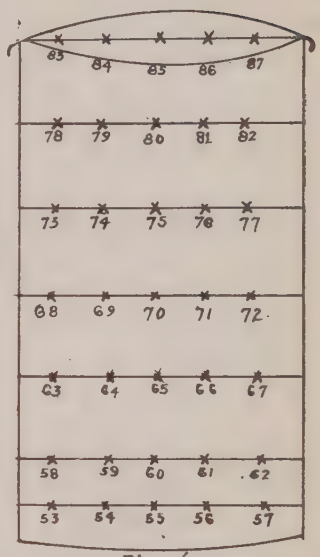

Fig. 6-a

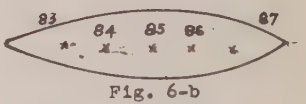

Fig. 6-b

(Showing end of bag)

These samples were taken along horizontal lines, at levels indicated, passing through center of bag. Large grain sampler used. The difference between these and the "levels" samples is shown by comparing Figure 5B and Figure 6B.

Definite conclusions may not be drawn from a preliminary experiment. However, attention is called to the following:

1. Averages of all analyses made on first and second blend seed are approximately the same (78.64 and 78.72%). This seems to indicate that purity analyses were correctly made.

2. There is greater variation in first blend than in second blend, which was to be expected.

3. Omitting samples taken by warehousemen from bulk, and by analysts from top and sides of bag, all tests of second blend came within the allowable variation.

4. Samples taken from top and near sides or bottom of bags are not dependable.

5. There is evidence that seeds were somewhat stratified when placed in bag with hand shovel. See Figure 7.

6. Samples taken from three different places, at least six inches from top, sides or bottom of bag should be reasonably accurate indicators of the average content.

Further experiments should be conducted to show:

1. Uniformity of seed in bulk after different blending operations.
2. Uniformity of seed in bags after different methods of filling.
3. Most accurate method of taking representative samples.

A METHOD FOR QUICKLY DETERMINING THE PURE SEED CONTENT OF BLUEGRASSES[1]

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The purity analysis is designed to determine the percentage of the kind of seed in a sample. Recently much discussion has centered around methods utilizing various type blowers and other apparatus designed to eliminate the seemingly wide variations which were stated to be present.

According to the official rules when working with chaffy grasses it is permissible to secure seeds for the germination test by making an "approximate separation" and reporting the "approximate purity" as well as the germination. While making these approximate separations and after repeatedly seeing the apparent dependability of the results it occurred to the writer that it might be a thoroughly practical procedure to use this shorter method in actual practice by using a strong reflected light with some form of visual apparatus or a good binocular. In order to obtain definite data a plan was followed by which two purity analyses were made on bluegrass samples as they arrived in the laboratory. One of these was the standard official method and the other was termed the "binocular method" because an excellent binocular with adjustable mirror and a strong light are used in our laboratory to obtain these so-called "approximate separations". Briefly, the binocular method as we have used it and as proposed consists simply of lifting off with a spatula or sharp spoon a portion, approximately 500 seeds, i.e. 0.10 to 0.15 grams, from the regulation test sample. This is placed in a long thin row on a separate and loose glas slab which is in turn placed on the glass stage on a binocular microscope and strong reflected light so adjusted that it will pass up thru the seeds and at an angle with the line of vision. With a fine forceps this portion, viewed at a magnification of about 20X is separated into "pure seed" and everything not pure seed. From the weights of these the percentage of pure seed is computed. In other words one is actually making a positive separation upon a small yet apparently representative sample but under very favorable conditions. If one wishes a complete analysis the remainder of the regulation test sample can be separated to obtain the percentage of weed seeds and crop seed, allocating the usual small error of analysis or computation into the inert matter percentage.

Experimental Results. - After completing a total of 75 analyses on routine samples by the two methods it was apparent when tests for accuracy were applied that the binocular method for determining the percentage of pure seed was just as dependable as the more tedious and time-consuming official method not being used. There was also a very marked saving in time since after a few trials one can easily reduce the analytical time by at least two-thirds.

As regards to the total pure seed content secured by the two methods it was found by comparing the results on 55 analyses or samples of Kentucky bluegrass that the pure seed percentage was 0.39% lower by the binocular method. Results on 6 stocks of Canada bluegrass seed of approximately 75% purity showed that the total pure seed percentage was 1.20% lower for the binocular method. The results on 11 stocks of Rough bluegrass averaged 0.59% lower pure seed content by the binocular method.

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In other words, the pure seed percentage secured by the binocular method rather consistently tended to be slightly lower than that secured by the official method in which case the pure seed and inert material separations, were checked over reflected light. This lower pure seed content is believed to be due to the fact that by means of a strong reflected light and ease of seeing what one is actually doing under the binocular magnification, one is able to rather quickly, consistently and safely bring the pure seed content down to approximately what it should be according to the principle implied in the present official rules.

In another series of 10 trials with sub-samples of the same bulk sample of Kentucky bluegrass seed both methods were compared as to time required, percentages of pure seed, and also, carried out to the end point to secure the pure live seed content. The results are shown in Table 1.

Table 1. - Results of 10 replicated trials on a bulk sample of Kentucky bluegrass seed to compare the official method with the binocular method.

	Pure seed		Germination		Pure-live seed	
Sample Number	Official method %	Binocular method %	Official method %	Binocular method %	Official method %	Binocular method %
1	90.35	90.71	83	81	74.99	73.48
2	89.70	91.28	83	83	74.45	75.76
3	88.10	91.16	78	82	68.72	74.75
4	88.65	88.92	82	87	72.69	77.36
5	87.90	88.37	86	83	75.59	73.35
6	89.25	89.14	81	84	72.29	74.88
7	89.90	91.33	81	85	72.82	77.63
8	88.00	88.75	85	85	74.80	75.43
9	88.95	90.89	83	86	73.83	78.17
10	89.75	88.92	82	86	73.60	76.47
Maximum T	91.46	92.16	89	91	78.84	80.80
MEAN	89.06	89.95	82	84	73.38	75.73
Minimum T	86.64	87.22	77	75	70.68	67.80
Difference	0.89					2.35
Time minutes	120	40				
Time saved minutes	80					

No attempt has been made to treat all of this data statistically, especially after it was noted that uniformly the results fell within the latitudes of tolerance allowed. That is to say, the results were just as reliable and as consistent as the samples themselves.

In order to ascertain the opinion of other workers on this proposed shorter method a request was made that they give it a trial on a sample of Kentucky bluegrass seed circulated for comparative testing. The results, being purely of a referee nature are not admisable here, yet the replies showed only seven technicians as having some objection to the method while several others had much to say in commendation of the method. The smaller size of sample was also questioned by some yet their results reported did not substantiate their contention.

Conclusions. - On the basis of present data it is the belief of the writer that this so-called binocular method for determining the pure seed content of bluegrass

and similar seed, by means of which a small random sample is positively separated into pure seed, is entirely practical, effects a great saving in time, is not as tedious, and is just as safe and dependable as the longer official method now being used.

Influence of Phytohormones on Germination and Growth of Cereals[1]

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Seeds in general, and those of the small grains in particular, are not popular experimental subjects for auxin or hormone studies. In an excellent review of growth hormones in plants Avery (1)[2] states that seedlings are enabled to grow in darkness because they obtain stored auxin from the seeds. Perhaps this supply of hormone is adequate to produce normal growth in the seedling and an additional introduced amount is usually superfluous.

Zimmerman (5) comments on the determination of, and stimuli from, certain hormones. No mention is made of application to, or extraction from seeds. Weimer (4) obtained measurable results from exposure of seeds of several species to aqueous solutions of indolebutyric acid. Concentrated solutions (40 p.p.m.) induced marked abnormalities and depressed germinative response. Dilute solutions, 1.2 to 10. p.p.m. slightly inhibited the elongation of the radicle while effecting increased secondary root development.

McRostie et al (3) not only studied the visual effect of hormone dusting of wheat seed but contained statistics on yields. Both vegetative growth and seed production were increased significantly by application of the hormones, indolylacetic and naphthylacetic acids, to certain varieties but not to others. Grace (2) found that the soaking of wheat seeds in solutions of indolebutyric acid reduced the injurious action of formaldehyde in blotter tests. Seedlings in soil flats were not benefitted from the hormone-solution soak.

Experimental Results. - During the past two years the response of winter barley, winter rye and winter wheat to the hormones, indolebutyric acid, indoleacetic acid and alpha naphthalene-acetamide has been investigated under field and greenhouse conditions. The former acid was received as "Auxilin" and a dust prepared from it using French talc as a carrier. The other materials were received in their solid form in inert dust carriers at a concentration of 1000 p.p.m.

In an experiment with Honor winter wheat the dust was applied at the rate of 1 part of material to 500 parts of seed. Indolebutyric acid was used in concentrations of 100 p.p.m., 200 p.p.m. and 300 p.p.m. New Ceresan was diluted with talc to obtain a 1% ethyl mercury phosphate dust.

The results as recorded in Table 1 were obtained from 5 replicates of treated lots and 20 replicates of control lots. These data indicate that the proper concentration of indolebutyric acid may increase the percentage of emerged seedlings. New Ceresan when applied in conjunction with any concentration of the hormone depressed the stand. It is significant also that the ratio of heads to seedling emergence was reduced by the addition of New Ceresan to any dust containing indolebutyric acid.

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[1]Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 416.
[2]Numbers in parenthesis refer to Literature Cited.

Table 1. - Influence of Indolebutyric Acid and of New Ceresan on Emerged Seedlings and Heading of Honor Wheat

Seeds dusted with	Emergence %	Heads per 100 seeds	Heads per seedling
New Ceresan	64.4	338	5.25
Indolebutyric acid 100 p.p.m.	67.2	348	5.18
Indolebutyric acid 100 p.p.m. and New Ceresan	60.8	312	5.13
Indolebutyric acid 200 p.p.m.	73.4	349	4.76
Indolebutyric acid 200 p.p.m. and New Ceresan	67.2	312	4.64
Indolebutyric acid 300 p.p.m.	64.2	328	5.11
Indolebutyric acid 300 p.p.m. and New Ceresan	61.0	310	5.08
Control	65.8	328	4.99

Selections of large, small, shrivelled, black point and broken seeds were obtained from a stock of Valprize wheat. Each selection was treated with New Ceresan containing 1% of ethyl mercury phosphate and with Rootone containing 0.1% of alpha naphthylane-acetamide. The dosage was uniformly 1 part of dust to 500 parts of seed.

Table 2. - Seedling Emergence and Winter Survival from Treated and Untreated Seed of Yorkwin Winter Wheat

	Seedling emergence			Winter survival		
Type of seed	Rootone	New Ceresan	Control	Rootone	New Ceresan	Control
	%	%	%	%	%	%
Large	85	93	87	80	82	85
Small	83	86	86	77	80	78
Shrivelled	83	69	72	69	65	64
Black point	90	95	90	86	87	86
Broken	47	85	39	35	66	28

The results expressed in Table 2 reveal the value of New Ceresan in protecting broken seeds against soil microflora. Rootone exerted only a slight protective action as measured by increased emergence.

The two hormones, alpha naphthalene-acetamide and indoleacetic acid, were compared with New Ceresan on whole, one-half and one-third seeds of Honor wheat. One-half or two-thirds, of the endosperm had been removed manually from each seed in the latter two lots. The materials were dusted on the seeds so that ratio of hormone to seed was 2 p.p.m. and of ethyl mercury phosphate to seed was 20 p.p.m.

In rich garden soil the germination of the whole seeds was not increased by any treatment while New Ceresan produced a 10% increase, indoleacetic acid a 6% and alpha naphthalene-acetamide a 1% increase in emerged seedlings from the mutilated seeds.

In heavy clay soil indoleacetic acid slightly increased the stand of both whole and mutilated seeds, while alpha naphthalene-acetamide and New Ceresan produced increases for the whole seeds only.

Several other varieties of winter wheat also were dusted with talc containing either of these hormones or New Ceresan. No statistically significant increase in emergence or winter survival could be demonstrated. In protected greenhouse soil the increases in germination were usually limited to 0.5 to 2.0%. In one experiment with smutted Yorkwin wheat the hormones plus New Ceresan effected gains of 5.5% while both New Ceresan and copper carbonate increased the stand by 9.5%.

In this experiment the dry weights of seedlings from the New Ceresan-treated seed were slightly greater than those for the controls. The addition of either indoleacetic acid or alpha naphthalene-acetamide to the New Ceresan dust more than doubled the gains over the controls.

The response of winter rye to seed treatments with the two hormones, indoleacetic acid and alpha naphthalene-acetamide, and to New Ceresan and copper carbonate was determined with 14 seedstocks in the field and greenhouse. Each treatment was replicated 4 times in both field and greenhouse. The materials were applied by shaking the chemical and seeds in a flask and sieving off the excess dust. The emerged seedlings in the field were counted at the 4-leaf stage. The data from the greenhouse replicates were obtained when the plants were 2, 3 and 4 months old.

Table 3. - Influence of Certain Hormones and Chemical Protectants on the Germination and Growth of Winter Rye

	Seedling emergence	Germination	Green weight		Dry weight	
Seeds treated with	in field	in greenhouse	Tops	Roots	Tops	Roots
	%	%	gms.	gms.	gms.	gms.
New Ceresan[1]	65.2	76.7	34.8	6.2	5.16	1.72
Copper carbonate[2]	55.9	65.0	24.5	4.2	3.80	1.35
Indole acetic acid[3]	62.3	74.1	31.1	5.1	4.87	1.59
Rootone[4]	64.0	73.7	29.9	5.1	4.63	1.58
Controls	62.5	75.1	31.6	5.4	4.87	1.58

[1]French talc added to produce a 1% ethyl mercury phosphate dust.
[2]Contains 20% copper.
[3]A dilution of 1 part of hormone to 1000 parts of talc.
[4]A dilution of 1 part of alpha naphthaleneacetamide to 1000 parts of talc.

The summary for the entire 14 seedstocks is included in Table 3. Copper carbonate adhered so heavily that an application of at least 5 ounces per bushel was obtained. This extreme dosage is replicated in depressed germination and decrease in growth as compared to the controls. The various seedstocks were consistently benefitted by New Ceresan. Growth increases were recorded for 11 of the lots while the germination from 9 New Ceresan-treated seedstocks exceeded those from untreated seedstocks. Rarely a replicate from any of hormone-treated lots produced more or heavier seedlings than either the New Ceresan-treated or the untreated lots.

The beneficial value of New Ceresan was demonstrable at any age of the seedlings from emergence to 4 months. The hormones caused no apparent increase in seedling weight during any stage in this period.

No evidence could be obtained in these or several other experiments to indicate that the phytohormones used at normal dosages inhibite development of mold fungi. The two species, Rhizopus nigricans and Alternaria tenuis, common on seeds of cereals were often more rampant on the hormone-treated than on the untreated seeds. Seedling blights were not affected by seed treatments with hormones.

DISCUSSION. - While these data are not consistently uniform for every experiment they show that neither indoleacetic acid, indolebutyric acid nor alpha naphthaleneacetamide dusted on dry seeds produce significant increases in germination, winter survival or seedlings weights.

That the condition of the soil may influence the action of the hormones is indicated by comparison of the results obtained in 1938 and in 1939. The treated seeds were planted in dry soil in September of 1938 and the seedlings emerged over a period of 3 weeks. Growing conditions were more favorable in 1939 resulting in a higher percentage of germination. Variations in the rate of dissolution and absorption of the hormones may account for the differences in germination.

The evidence does not demonstrate varietal reactions in winter grain. Although slightly more significant results were obtained from Honor than from Valprize or Yorkwin wheat these probably were due to the differences in soil moisture.

It seemed reasonable from a survey of the pertinent literature that hormones might be beneficial to embryo fractions of wheat seeds. Neither hormone used in these studies significantly increased the percentage of plants surviving the winter. Presumably then the hormones dusted on the mutilated seeds either did not substitute for those stored in the endosperm or this latter supply, if originally present, was superfluous for development of the seedling.

SUMMARY. - Several concentrations of indolebutyric acid dusted on seeds of Honor winter wheat increased the percentage of emerged seedlings and the total number of heads. The addition of New Ceresan to the hormone dust depressed both the percentage of emerged seedlings and the ratio of heads to seedlings.

Alpha naphthaleneacetamide slightly increased the number of emerged seedlings and the winter survival from shrivelled seeds of Yorkwin winter wheat. No beneficial result were noted from application of this hormone to the normal or the broken seeds. New Ceresan in general was superior in producing thicker stands.

Neither indoleacetic acid nor alpha naphthaleneacetamide produced significant increases in the germination of winter rye in either greenhouse or field. The dry weights of the plants were not affected by application of hormone dusts to the seeds.

New Ceresan used as a seed treatment was consistently effective in increasing the green and dry weights of winter rye plants as compared to those grown from hormone-treated or untreated seeds.

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The Evaluation of Hard Seed in Annual Lespedezas when the Germination Test is made soon after Harvest

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The evaluation of hard seed in annual lespedezas when the germination test is made soon after harvest is of considerable interest to seedsmen and seed laboratories of the lespedeza seed producing areas. Often the actual germination is less than 10% with the hard seed being 80% to 90%. It is necessary to make germination

tests soon after harvest in order that the seed may be distributed in time for seeding of the new crop, which in some sections, is as early as February.

Materials and methods. - A study was made of 53 samples of Korean lespedeza[1], 26 samples of common lespedeza[2], 14 samples of Tennessee 76 lespedeza[3], and 60 samples of Kobe lespedeza[2]. The first tests in all cases were the routine germination tests made by the North Carolina seed laboratory. The date of the first tests covered the period from October 10, 1939 to December 1, 1939. The second tests were started May 8 and 9, 1940. All germination tests were made under the direction of Miss Susie Allen, Supervising Analyst of the North Carolina seed laboratory. The tests were made at the alternating temperatures of 20-35°C.

KOREAN LESPEDEZA: Of the 53 samples of Korean lespedeza which were studied, it was found upon completion of the second test that the actual germination of 15 of these samples was less than 70% and the hard seed percentage was correspondingly high. When these samples were further examined, it was found that 10 of the 15 were marked second or third grade seed[4], and of the remaining 5 from 56% to 85% would pass through a screen that would retain from 60% to 80% of well cleaned lot of Korean lespedeza seed. Middleton[5] found that late in the spring when Korean lespedeza had been separated into three sizes that the large seed fractions showed only 1% to 3% hard seed while the smallest size seed contained from 46% to 72% hard seed. Seed intermediate in size were intermediate in percentage of hard seed. Since the above observations made by Middleton coincide with those made by the writer and since it is necessary to screen out the small seed in Korean lespedeza in order to obtain good quality seed, the 15 samples containing a high percentage of small seed were not further considered. Of the remaining 38 samples, it was found that the germination plus the hard seed were equal to 90% or more on the first test and in every sample the actual germination in the last test was higher than 70%. The lowest actual germination on the second test was 71.5% and the highest 93.5%.

COMMON AND TENNESSEE 76 LESPEDEZA: The actual germination of the first tests made on samples of common and Tennessee 76 lespedeza were relatively low, the average being 11% for 40 samples, the extremes being 0.5% and 28% respectively. The average actual germination of the second tests made in May was relatively high being 90.4%, or only 3.7% lower than the average actual germination plus the hard seed of the first test. The greatest difference between the actual germination plus the hard seed of the first test and the actual germination of the second test of any sample was 11%.

KOBE LESPEDEZA: The actual germination of the 60 Kobe lespedeza samples on the first test averaged 17.2% with the extremes being 1% and 45.5% respectively. The average actual germination on the second tests was 74.1% or 18.1% lower than the average actual germination plus the hard seed of the first test. The germination percentages varied considerably on the second tests. One was within 0.5% of the actual germination plus the hard seed of the first test and the other extreme was the actual germination 39.5% lower than the sum of the actual germination and the hard seed of the first test.

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[1] Lespedeza stipulacea
[2] Lespedeza striata
[3] Tennessee 76 lespedeza is a strain selected from common lespedeza and the seed cannot be distinguished. Since no difference was noted in their behavior in the tests, the two varieties are treated as one.
[4] Korean lespedeza seed cleaners often separate the seed into two or three grades, the seed from the top screen containing the large, well matured seed and the other grades containing the smaller seed. This separation is made to remove dodder and other small weed seeds.
[5] Middleton, Gordon K. Size of Korean lespedeza seed in relation to germination and hard seed. Jour. Amer. Soc. Agron. 25: 173-177. 1933.

Of the 60 Kobe lespedeza samples tested the actual germination of the second test of 12 was 20% to 25% lower than the sum of the germination plus the hard seed of the first test: 4 were 25% to 30% lower than this total; and 3 were more than 30% lower, making a total of 19 that were more than 20% lower.

Summary and conclusions.

1. When the germination test is made soon after harvest on well-screened Korean lespedeza, if the total of the actual germination and the hard seed equal 90% or more, an actual germination by late spring of the following year will be 70% or more.

2. When a germination test is made soon after harvest on common or Tennessee 76 lespedeza, the total of the actual germination and the hard seed minus 10% is a conservative estimate of what the actual germination will be late the next spring. Of 40 samples that were studied the average actual germination on the second test was 3.7% lower than the above total, and the extreme was 11% lower.

3. From the observations of the writer, definite conclusions cannot be reached by considering the actual germination plus the hard seed of Kobe lespedeza when the test is made soon after harvest without further study. With some samples the actual germination on second test approximated the total of actual germination and hard seed of an early test, but with others the actual germination was almost 40% lower than this total. The nature of the seed hull of Kobe lespedeza makes it impractical for a separation of the large and small seed; therefore conclusions such as were reached with Korean lespedeza cannot be formulated.

Response of Germinants from Beans, Corn and Peas to Seed Treatments with Hormones and Mercurials[1]

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The phytohormones, indoleacetic acid, indolebutyric acid, indolepropionic acid, naphthaleneacetic acid, alpha naphthaleneacetic acid, alpha naphthalene acetamide and others have been found valuable in the rooting of cuttings. Attempts to utilize these growth substances by direct application to seeds have met with insignificant and conflicting results. In certain experiments the winter grains have responded to seed treatment with very dilute concentrations of a hormone suspended in talc. Seeds of certain species of flowers have been benefitted by hormones, particularly alpha naphthaleneacetamide.

Whether or not this beneficial effect of the growth substances would assume measurable proportions has been determined for the seedling stage of dry shell and snap beans, sweet corn, lima beans and peas under laboratory conditions. References to the fungicidal action of alpha naphthaleneacetamide suggested its comparison with the mercurial seed disinfestants. During the routine germination of unselected stocks of these seeds indoleacetic acid, indolebutyric acid and alpha naphthaleneacetamide were dusted on the dry seeds immediately prior to placing them in the germinators. Since the size of the samples prevented accurate determination of dosage the hormones were suspended in an inert carrier having an adherence rate on these seeds of about 2 ounces per bushel or 0.2% by weight.

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[1]Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 425.

Table 1. - Comparative Reaction of Seedlings and Contaminants to Seed Treatment with Rootone or Ceresan.

Kind of treatment	Germination	Plumules, length	Radicles, length	Seeds or seedlings with Rhizopus nigricans	Penicillium spp.	Bacteria
	%	in.	in.	%	%	%
PEAS						
Rootone	76	2.50	3.54	48.1	18.2	20.9
Ceresan	84	2.84	4.17	12.4	1.7	0.8
Control	76	2.27	3.47	51.5	21.8	20.6
CORN						
Rootone	84	3.17	3.96	76.0	39.2	9.2
Ceresan	87	3.50	5.26	20.1	7.2	0.0
Control	86	2.86	3.84	77.2	30.8	11.2
BEANS						
Rootone	95	2.37	4.84	17.5	4.0	0.5
Ceresan	96	2.54	4.76	10.0	0.0	0.0
Control	94	2.43	4.90	10.0	12.0	4.0
LIMA BEANS						
Rootone	65	2.20	4.44	48.9	28.8	39.7
Ceresan	68	2.08	4.41	16.1	10.8	9.0
Control	73	2.41	5.01	48.1	22.0	18.6

Table 2. - Comparative Influence of Rootone, New I. Ceresan and Mixtures of Rootone and New I. Ceresan on the Germination, Seedling Growth and Contaminants of Corn, and Garden Beans.

Kind of treatment	Germination	Plumules, length	Radicles, length	Seeds or seedlings with Rhizopus	Penicillium	Bacteria
	%	%	%	%	%	%
BEANS						
Rootone	73.5	1.61	4.34	30.0	19.0	2.5
New I. Ceresan	77.0	1.62	4.46	0.0	0.0	0.0
Mixture	77.0	1.55	4.34	0.0	1.5	1.0
Control	84.5	1.26	4.18	20.0	7.5	2.0
SWEET CORN						
Rootone	97.3	1.28	3.34	41.3	3.3	-
New I. Ceresan	95.7	1.31	3.41	0.3	1.0	-
Mixture	98.0	1.26	3.29	0.3	1.3	-
Control	93.7	1.16	3.11	23.3	1.3	-

Table 3. - Influence of Certain Hormones and Mercurials on the Germination, Seedling Growth and Contaminants of Large Agricultural Seeds. All Data Expressed as Gain or Loss of Dusted Over Control Seeds.

Seeds dusted with	Germination	Plumule length	Radicle length	Seeds or seedlings with Rhizopus nigricans	Penicillium spp.	Bacteria
	%	in.	in.	%	%	%
Indoleacetic acid	-11.	+.42	+.27	0	-8	0
Alpha naphthalene acetamide 2,000 p.p.m.	- 3.	+.29	-.33	+23	-10	0
Alpha naphthalene acetamide[1] 2,000 p.p.m.	- 4.	+.49	+.20	-74	-20	-2
Alpha naphthalene acetamide 4,000 p.p.m.	- 1.	-.28	-.37	+ 8	- 7	-2
Alpha naphthalene acetamide[1] 4,000 p.p.m.	- 1.	+.15	-.02	-72	-24	+1
Alpha naphthalene acetamide 10,000 p.p.m.	- 7.	+.02	+.39	+ 5	+ 1	+4
New Improved Ceresan, in talc	- 1.	+.20	+.29	-74	-25	-3
Merko	+ 2.	+.17	+.19	-45	- 9	-6
Control	89.	2.47	3.77	76	26	8

[1] One part of New Improved Ceresan added to five parts of hormone dust.

The material known in the trade as Rootone containing 0.1% of alpha naphthaleneacetamide was studied extensively in the laboratory. Usually a soluble mercurial, commercially known as Ceresan, was included in the experiments.

Only a few of the results can be presented at this time. Those included in Table 1 are representative evidence of the ineffectiveness of alpha naphthaleneacetamide as a fungicide. In a few tests the presence of this hormone appeared to increase the incidence of mold and bacterial contamination. This is indicated by the averages from seven samples of lima beans in Table 1. All of the data in Tables 2 and 3 are in agreement with this latter observation.

The tabulations from approximately 600 samples of the large agricultural seeds definitely negate any claims of fungicidal value for the commonly compounded concentrations of the hormones. More concentrated dusts employing alpha naphthaleneacetamide as the active ingredient proved no more effective than Rootone, and as shown by the date in Table 3, actually promoted the growth of Rhizopus nigricans. Both fungi, notably Penicillium spp., and bacteria were found on slightly fewer seedlings in the hormone-treated than in the untreated tests.

The proprietary dusts, Ceresan, Merko and New Improved Ceresan which contain mercury in various forms were highly effective in mold elimination. New Improved Ceresan seemed equally effective in the presence or absence of alpha naphthaleneacetamide. As shown in Table 3 the percentages of fungus- and bacterial-infested sprouts were reduced to practically nil when a dust composed of 1 part of New Ceresan and 5 parts of the hormone dilution in talc was applied to the dry seeds.

Mold-infested peas are usually benefitted by treatment with Ceresan. An apparent increase in germination is commonly noted. This increase is somewhat proportional to the reduction in rotting induced by the contaminating molds and bacteria. The application of Ceresan to clean, new-crop stocks of peas may effect an increase in the lengths of plumules and radicles within the six-day germination period.

Rootone has also increased the size of the seedlings of peas. It will be observed from Table 1 that this increase is not attributable to control of the seed contaminants or to the number of normal sprouts. In approximately 75% of the tests with peas and corn the Rootone-treated germinants were superior in size to the untreated sprouts. The order of length of seedlings was commonly Ceresan, Rootone and untreated but rarely the Rootone-treated germinants ranked first. The lengths of both plumules and radicles of inch classifications are shown in Figure 1 and similar measurements for sweet corn are shown in Figure 2.

Lima beans did not respond to treatment with Rootone. This statement applies to both clean and contaminated seedstocks.

The data from beans appears to be conflicting. The results in Table 1 were averaged from measurements with garden varieties whereas those in Table 2 represented dry shell beans and only the Bountiful variety of garden beans. The reaction of these types of the hormone may be dissimilar but the differences in rates of adherence of the dust could conceivably be responsible for these results.

The hormones mentioned in these studies were ineffective in increasing the percentage of normal sprouts and often depressed the germination of garden beans and lima beans. The percentages for peas in Table 1 very probably are reliable in this regard. Increases in germination for peas are invariably occasioned by control of molds and bacteria and apparently only through this means.

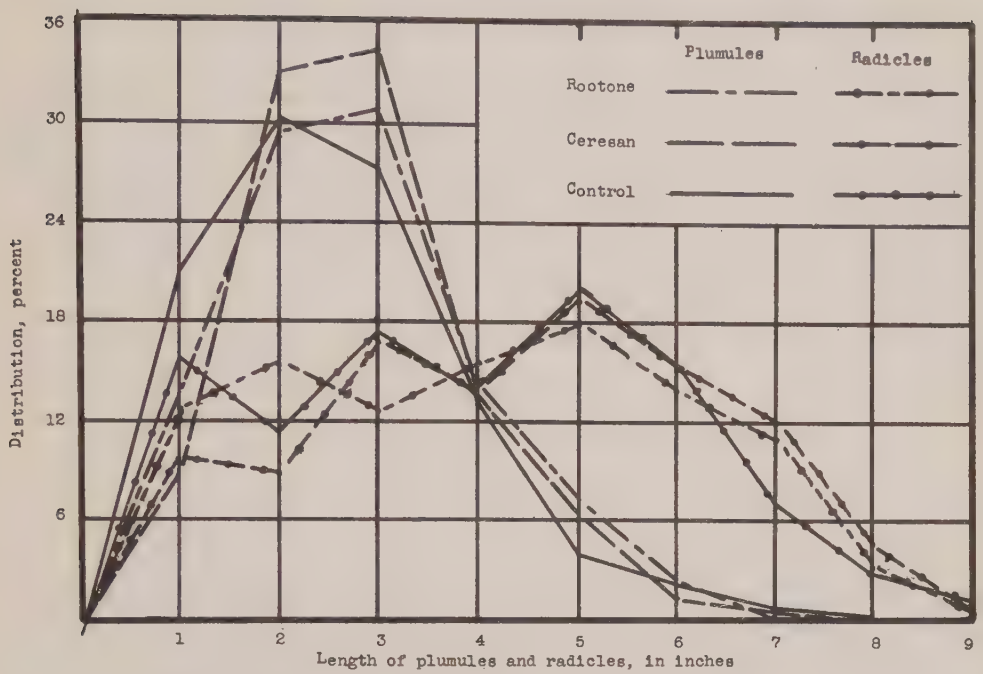

Figure 1.- Distribution of lengths of plumules and radicles for garden peas.

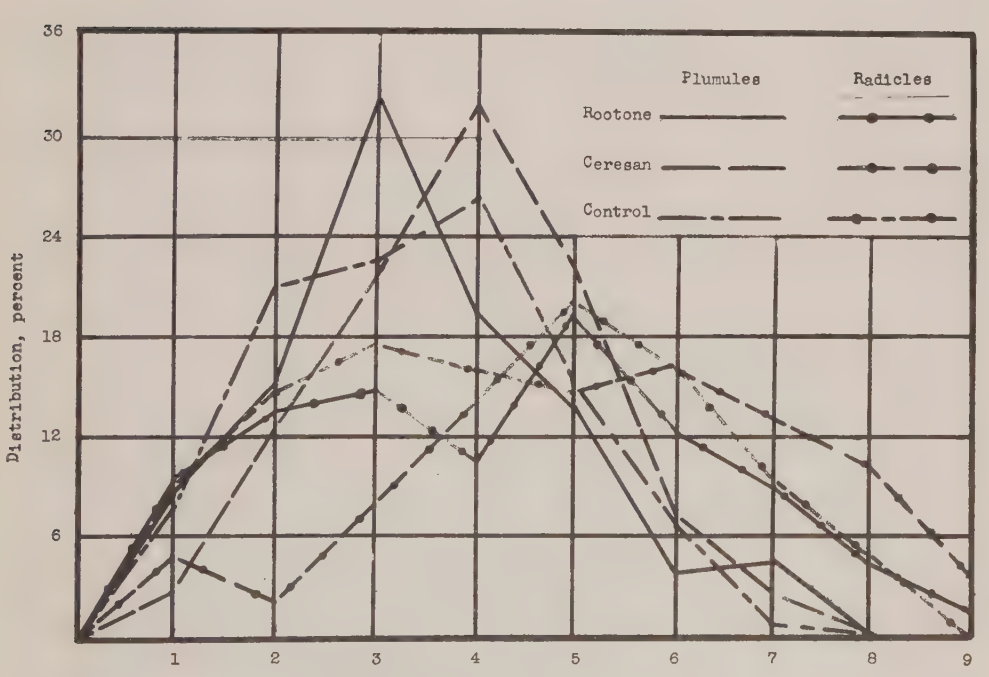

Figure 2.- Distribution of lengths of plumules and radicles of corn seedlings in one-inch frequencies.

Summary. The hormone, alpha naphthaleneacetamide, may effect growth increments in seedlings from pea seed. Corn and garden beans exhibit only a slight response to application of hormones to the dry seed.

The incidence of fungus- and bacteria-infested germinants was not reduced through seed treatment with any hormone. Alpha naphthaleneacetamide has occasionally increased the percentage of contaminated seedlings.

As measured in percentages of normal sprouts pea seedstocks failed to respond to additions of any hormone. The germination of lima beans was commonly less for the treated than for the untreated seed. The results from garden beans and corn were inconsistent. The differences in percentages of germination between the hormone-treated and the untreated seed were not significant.

The Effect of Light and Temperature on the Dormancy of Scotch Pine Seed

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The use of Scotch pine (Pinus sylvestris) in New York State has been covered by York and Littlefield (9)[1]. Interest in specific races of this species goes back to 1924 when the New York State Conversation Department received seed from various localities in Sweden through the efforts of H. I. Baldwin (2). In 1927 local collections were made by the Department from naturalized trees near Boonville, N. Y. (3). The latest series of seed lots were obtained from numerous localities in Europe through the cooperation with Dr. Baldwin, a member of the seed committee of the International Union of Forest Research Organizations. These have been supplemented with special lots of seeds obtained through European cooperators, commercial shipments from Europe and seed collections from plantations within the state.

The planting stock of these special lots is being propagated in the experimental sections of the Saratoga nursery operated by the Conservation Department. Systematic germination tests of all seed lots were started in 1931 as a matter of routine. In addition special tests have been run on many lots to help solve the practical problems that arose during the propagation of the various stocks in the nursery. Many of these lots have found their way into forest plantations. Littlefield (5) has reported some preliminary results with a part of the earlier plantings.

In the northern part of this country coniferous seed can be sown in the nursery in the fall or in the spring. The seed that is sown in the fall is not expected to germinate until the following spring. It has been reported by the senior writer (3) that certain species such as eastern white pine (Pinus strobus) and white spruce (Picea glauca) germinate better if sown in the fall, while Norway spruce (Picea excelsa) germinated poorly, since it pregerminated in the fall. In the case of Scotch pine two lots pregerminated while the other did not. The results of sowing two of these lots in the fall of 1934 at two-week intervals are shown in

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*Mr. Heit was connected with the N. Y. S. Conservation Dept. for 8 years prior to November 1, 1939.

[1]Numbers in parentheses refer to Literature Cited.

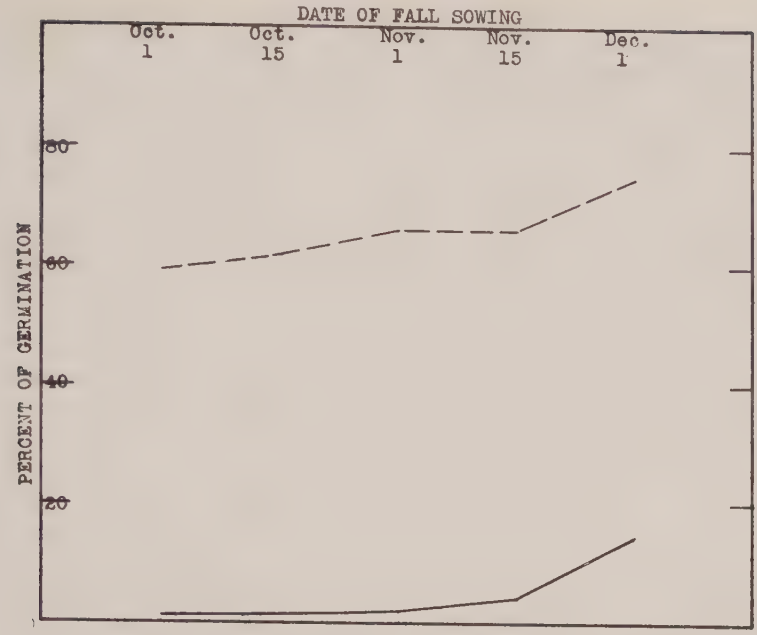

Figure 1. Field germination based upon the number of viable seed sown at different times in the fall. The recorded germination took place the following spring. The lack of germination recorded is due to pre-germination in the fall. The dotted line represents a lot of seed collected near South Colton, N. Y. The solid line indicates a lot collected near Madgeburg, Germany.

Figure 1. This confirmed the results of sowings made the previous fall in which a number of lots were sown in direct comparison with sowings made the following spring. The results showed practically an equal germination between lots sown in the fall and spring. There was one notable exception in which the fall-sown plot produced only 98 trees as compared with nearly a thousand trees from the same lot sown in the spring. The wide difference could not be explained by casual observation of the plot itself. The exceptional seed lot, however, was from a European source, while all the others were collected from plantations growing in New York state.

A similar sowing was made in the fall of 1935, using in addition another European lot. The results were the same. The European lots pregerminated, while the New York lots failed to do so. Observations made on the seed beds sown in the years of 1934 and 1935 during the fall season confirmed the belief that actual germination was taking place, since a part of the germinating seed could be seen above the ground.

In this connection it is of interest to note that a lot of seed collected near Forestport, N. Y., when sown in the fall, produced more trees than when sown in the spring. The tree per cent based upon the number of seed sown was 43 for the fall-sown and 21 for the spring-sown.

These field plots thus demonstrated that pregermination was an actuality in the European lots and that there was a wide difference in the response of the different lots to fall sowing. Efforts made to determine the cause of the difference were then confined to the laboratory.

All of the lots had been given the routing tests in the Jacobsen type germinator at a more or less constant temperature of 25° C and in diffuse daylight, but no such striking differences had been detected. However, since some lots germinated in the cool, fall-sown seedbeds and others did not, it was believed that possibly the lots might have different temperature requirements. Therefore, the first series of laboratory tests were made with a relatively low temperature, ranging from 10 to 18° C in a small Jacobsen type germinator. In this series the seed was subjected to a temperature of 10°C for a period of 30 days and then moved to a temperature of 18°C for an additional 20 days. The results for the 36 lots of seeds are shown in Table 1. During the first period the average germination

Table 1. - The Average Germination of Several Lots of Scotch Pine Seed from European and New York State Sources

Source	Number of lots	Average germination, with the range observed, and conditions for germination.		
		30 Days at 10°C No light %	Additional 20 days at 15°C No light %	30 days at 25°C Diffused sunlight %
European	13	54.7(27.0-72.0)	83.5(61.0-93.0)	86.3(64.0-97.0)
New York (1)	8	19.0(11.0-37.0)	92.5(86.0-99.0)	94.6(80.0-97.0)
New York (2)	16	0.5(0.0-3.0)	80.3(44.0-96.0)	80.6(33.0-97.0)
Total	36			

[1]. The data is based upon but 100 seed per lot, and only the average of several lots is considered significant.

of the 12 European lots was 54.7% as compared with 19.0% in 8 of the New York lots, and 0.5% in the 16 other New York lots. The later groupings were made arbitrarily on the basis of germinability during this period. The range of germination among the lots is given in the table after the average in each case. At the end of the additional 20 days, the average germination of all lots was nearly equal that obtained in the regular Jacobsen germinator in 30 days at a temperature of 25° C. The first explanation for the low germination of the New York lots during the first period was based upon what seemed to be different temperature requirements. These lots did not pregerminate in the fall-sown nursery beds because they required a higher temperature for germination than the European lots. This explanation, however, did not hold when other tests were applied and completed.

It may be noted in Table 1, that the conditions for germination as given in the first column and the last column, were not only a difference in temperature, but also a difference in the light conditions. The former was made in the dark, while the latter was made in diffused daylight. The factor of light must be considered, since it was generally known that light affects the germination of some seed. In order to determine the effect of light, another series of tests were run at a low temperature, with and without light. The results are shown in Figure 2 when two lots were germinated under three conditions. In diffused light at 25°C both lots reached the same per cent germination in 15 days. In constant electric light at 13°C the germination was delayed and finally somewhat less than in the previous condition, but nearly the same for the two lots. Under the same conditions of temperature, but without the light, the germination was delayed and reduced in the European lot, but to a much lesser degree than in the New York lot. The latter germinated but 47% at the end of 30 days as compared with 80% for the former. These results led to the conclusion that the factor of temperature only

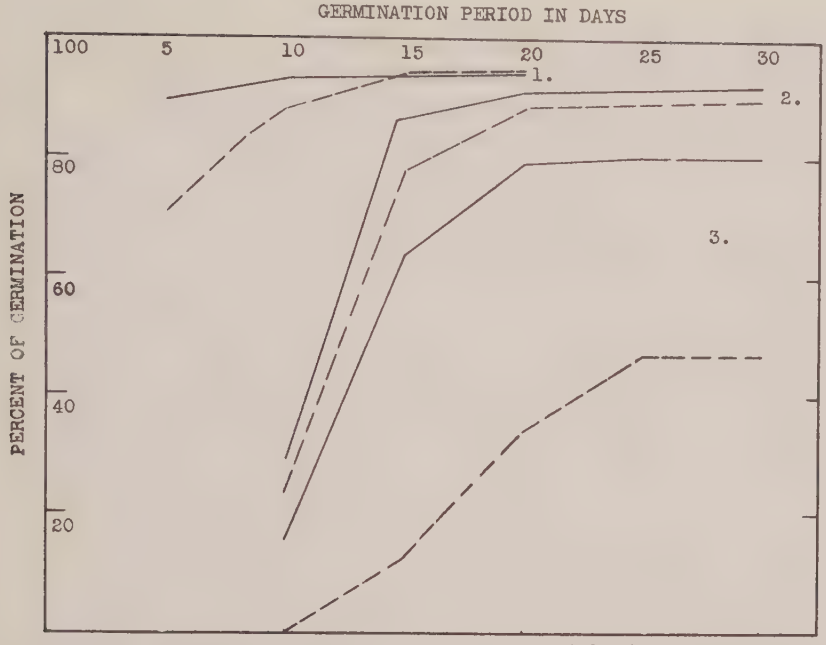

Figure 2. The germination of two lots of Scotch pine under three different conditions. The solid line indicates a European lot collected near Madgeburg, Germany. The dotted line indicates a lot collected in New York State near Boonville. Condition 1. In Jacobsen germinator with a temperature of 25°C in diffused daylight. 2. In special Jacobsen type germinator with a temperature of 13°C under constant electric light. 3. The same as 2. but seed covered with black funnel to exclude the light.

delayed germination, whereas the light factor was much more important in effecting germination. This, nevertheless, would not explain the germination of the several lots in the second column in Table 1, since this germination took place in the dark, the difference being only that of a higher temperature. While it may be granted that the change in temperature might have a stimulating effect and that during the movement to the higher temperature the seed may have received some light, there remained an additional explanation necessary for the germination in darkness.

The seed lots which have given low germination in darkness were known to be viable, since they contained many "sound" seed at the end of the normal test period and did actually germinate in the light. Therefore, this seed seemed to be in some state of dormancy. As it is common practice to pre-chill or stratify dormant seed in order to obtain rapid and complete germination, several of the more dormant lots were pre-chilled for 25 days at a temperature of 3°C. The treated seed was then placed in the regular Jacobsen daylight germinator at a constant temperature of 25°C. One-half of the test samples were covered with black glass funnels to exclude the light, while the other half were covered with clear glass funnels. At the end of seven days all the lots had germinated 95% or better, under both the dark funnels and the clear ones. Therefore, seed in a state of dormancy would germinate in the light without being after-ripened by pre-chilling, and would also germinate in the dark after pre-chilling. In other words, the effect of light took the place of the influence of pre-chilling. This would explain the variable germination of the seed as shown in the second column in Table 1. The first 30 days was a period of pre-treatment for the lots which

needed it, and then during the following 20 days germination took place even in the dark.

All the seed lots of Scotch pine germinated in the dark have indicated some degree of dormancy. Even in the European lots there are several which do not germinate completely in the dark. This is in agreement with the statements of Schmidt (7), who according to Baldwin, is quoted as stating that "light is indispensable for complete germination of Scotch pine---". According to the experience here recorded, this ranges to lots which germinate almost completely in the dark. Some of the factors causing this dormancy will be discussed subsequently.

In view of this laboratory experience, it is now necessary to explain the reason for the pregermination in the fall-sown seedbeds with the European seed lots. The European lots are in gereral the least dormant and therefore are ready to germinate as soon as sown. As temperature regulates the speed of germination, the earlier the seed is sown in the fall the greater will be the amount of pregermination. This tendency is shown in Figure 1. However, the latest sowing showed much pregermination, due to the fact that the temperature was still apparently too high, i. e. not cool enough, to check it. The more dormant lots as represented by the New York Collections are not ready to germinate, and therefore germination does not take place until the following spring, at which time the seed has become "pre-chilled" by the winter temperature. This seed when sown in the spring will germinate, but at a rate in accordance with its degree of dormancy. During the spring months the soil temperatures are higher than in the fall[1], and increases each week as compared with a gradual lowering in the fall, therefore the rate of germination is increased. At the same time the daily alternating temperature stimulates the after-ripening process, so that germination takes place. As mentioned above, some lots which display considerable dormancy germinate better if sown in the fall. When these lots are sown in the spring, much of the germination is delayed and even held over until the second year. One such lot sown in the spring of 1938 in the nursery germinated by 31% at the end of 115 days, yet had a potential viability of 97%.

When the factor of light is considered again, the above explanation is based upon the absence of light in the seedbeds. Otherwise, if the dormant seed was exposed to the light it would pregerminate in the fall-sown seedbeds, just as the so-called "non-dormant" seed does. The ordinary covering of one-eighth of an inch of sand used on the seed after sowing is an effective screen against the light. This has been demonstrated by covering the glass top of a strongly lighted box with an eighth of an inch of sand. If the sand covering is smooth no light rays can penetrate, but if the sand surface is rough, as it would be when sifted onto a seedbed, small spots of light could be seen. These small spots of light may or may not affect the germination of dormant seed, since the burlap or mulch used over the seedbeds until germination takes place, greatly reduces the intensity.

The quantity and quality of light necessary for the germination of dormant seed is of interest. Part of the efforts made to determine this are shown in Table 2 with six lots of seed and illustrated for two lots in Figure 3. The germination under 7-1/2, 15 and 50 watt electric lights producing white light showed no difference. This indicated that the minimum light intensity was not reached. Further tests not herein reported indicated that the light intensity may be reduced

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[1] The mean temperature for six years, 1931-1936 inclusive, at the Saratoga nursery, for the months of May, 55°F., June 64°F., October 47°F. and November 34°F.

Table 2. - The Germination After 20 Days of Six Lots of Scotch Pine Seed Under Several Light Conditions[1].

Source of Lot	Source of Light Conditions						
	7-1/2 watt bulb	15 watt bulb	50 watt bulb	75 watt red bulb	In Darkness	75 watt blue bulb	15 more days.[2]
Madgeburg, Ger.	87	87	87	87	72	43	87
Wurttemburg, Ger.	70	77	68	67	30	9	83
Saratoga, N. Y.	92	86	90	82	6	3	92
Forestport, N.Y.	89	85	88	88	10	3	95
Colton, N.Y.	99	95	96	96	51	11	97
Boonville, N.Y.	94	95	97	98	32	3	98
Average	88	87	87	86	35	12	92

[1]Tests made on small Jacobsen type germinators located in chambers with various electric lights, which were on constantly during the tests.
[2]At the end of 20 days under the blue light, the seed was moved to a lighted chamber for 15 days more.

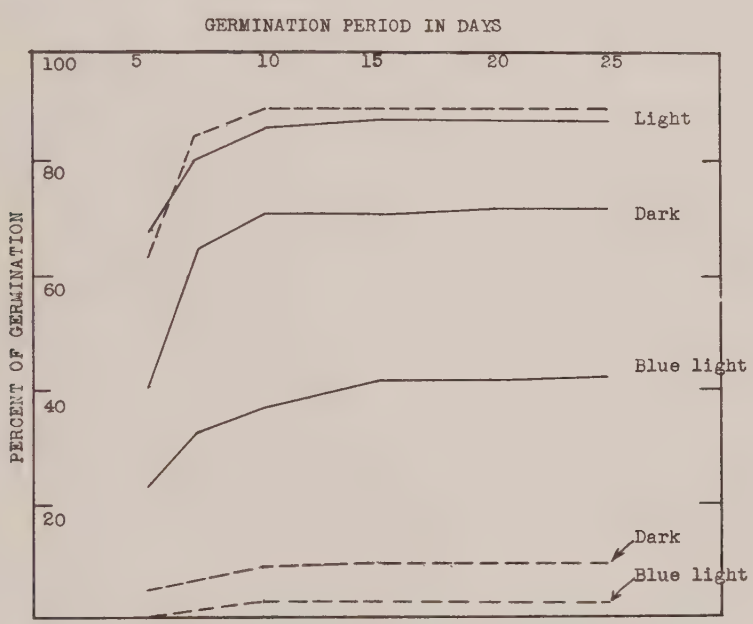

Figure 3. The trend in germination of two lots of Scotch pine under different conditions of light. The solid line represents a lot collected near Madgeburg, Germany. The dotted line represents a collection made near Forestport, N. Y. Reading from top to bottom for each lot the light condition was constant electric white light, dark and constant "natural" blue electric light. All with a constant temperature 24°C.

to a point where the funnels used were barely distinguishable to the eye and yet be sufficient to produce nearly complete germination. There is need for further tests in which the germination is correlated with accurate unit measurements of light intensity. Table 2 and Figure 3 show that the germination under the red light was equal to that in the white light. On the other hand, the blue light reduced the germination below that with no light. This point was further confirmed by additional tests. After the seed had been subjected to the blue light for 20 days, it was moved to the white light for 15 more days (Table 2). The result was complete germination. This indicated that the seed became more dormant

[illegible] light but recovered in the white light. The seed which had been in the dark for 30 days was treated likewise with the same recovery. Flint (4) has shown that blue light produces a state of dormancy in lettuce seed. He also showed that a flash of white sunlight of four seconds duration would produce rapid germination in lettuce seed.

It has been stated above that temperature controls the rate of germination. However, a number of tests with the dormant seed in the daylight Jacobsen germinator showed that they completed their germination only after 60 to 100 days. The temperature in the regular Jacobsen germinator is constant at 25°C. Tests of one of the more dormant lots showed a more rapid germination at 18°C. It is possible that the 25°C temperature is too high and because of that some of the seed become more dormant, causing a delay in its complete germination. Shuck (8) found that dormant lettuce seed became more dormant at higher temperatures. At 20°C freshly harvested lettuce seed went into a state of dormancy, but this reaction became less so, as the temperature was lowered. The results obtained with one lot of Scotch pine are shown in Table 3.

Table 3. - The Germination of Scotch Pine Seed as Related to Light Source and Temperature.[1]

Type of light	Temperature	Germination in days			Germinative capacity of seed
		5	7	10	
	Degrees C.	%	%	%	%
Constant white electric light	24	54	82	89	99
Dark (Funnel)[2]	24	3	6	6	97
Constant white electric light	18	93	97	98	98
Dark (Funnel)	18	5	7	7	97
Daylight [illegible]	24	23	49	58	94
Dark (Funnel)	24	3	8	9	99

[1]Seed collected in 1938 from a single tree (No. 1) growing near the Saratoga nursery, Saratoga County, N. Y.
[2]Black funnel covered seed in lighted chambers.

[illegible] that lettuce seed when freshly harvested was more dormant, as was seed before [illegible] it became less and less dormant, and less apt to be thrown into a further dormant state with high temperature, etc. One of the more dormant lots of lettuce seed collected in 1936 was germinated three years later. In the light it germinated 82% in 20 days, while in the dark no germination took place in the same length of time. This would indicate that at least for three years no change had taken place as far as its state of dormancy was concerned. Similar results with other lots could be cited.

In considering the possible cause of dormancy, it occurred to the writers that the time of cone collecting should be considered. Starting in August 1937 and extending to February 1938, a series of collections were made from a single tree [illegible] near the Saratoga nursery. The collection, extraction and germination [illegible] were all made in an identical manner so as to eliminate all factors except time of collection. The results are shown in Table 4. It will be seen that there is a very gradual increase in the rate of germination under the three conditions [illegible] following the time of collection. It is evident that the August

Table 4. - The Germination of Scotch Pine Seed in Relation to the Time of Collection

Test No.	Date[2] collected	Germination in Days								
		In Jacobsen germinator in daylight		In Jacobsen germinator in darkness					In sand	
		7	20	7	20	30	60	60[1]	20	80
		%	%	%	%	%	%	%	%	%
703	8/17/37	14.5	44.0	0	3.5	6.5	28.0	37.0	2.0	10.0
704	9/1/37	69.5	86.0	.5	4.0	7.5	24.0	73.0	16.0	74.0
705	9/18/37	64.0	86.5	1.0	2.0	3.0	29.0	87.0	16.0	92.5
706	10/2/37	89.5	97.5	13.0	13.5	19.5	63.0	93.0	54.5	97.0
707	10/18/37	85.5	95.0	17.5	17.5	22.5	42.0	97.0	57.0	95.0
708	12/21/37	80.0	87.0	20.5	20.5	25.5	64.0	98.0	78.0	94.0
709	2/18/38	95.5	95.5	21.0	24.0	31.0	95.0	95.0	79.0	99.0

[1]At the end of the first 30 days moved to a room temperature of 15°-25°C.
[2]All seed collected from a single tree (No. 2) growing near the Saratoga nursery, Saratoga County, N. Y.

collection was too early, and possibly those made in September, for the seed never reached the highest possible germination as is indicated by the later collections. In these early collections the seed may be said to be "physically immature", as compared with the later collections which are physically mature but in a state of "physiological" dormancy. However, even in the latest collection the majority of the seeds are in a dormant state, in that they germinated but 24% after 20 days in darkness as compared with 95% in the light. Five other lots collected in widely separated counties in the state (Lewis and Saratoga) during March and April, germinated on the average of 40% in darkness after 30 days, yet the seed had a 90% viability. Therefore, some of the dormancy is probably due to early collection, but there remains some other explanation for the complete condition.

Baldwin (2) in reporting the work of Schmidt stated that the behavior of Scotch pine seed to light and darkness during germination furnished one of the best indices to origin. He cited examples of several collections made in different parts of Europe. In one case a lot collected in Scotland germinated but 13% lower in darkness than in light, yet another lot collected in Poland showed a difference of from 85 to 95% between the two conditions. Just how much this inability to germinate in the absence of light and the various conditions of dormancy are related to seed sources or tree races is beyond the scope of this paper. Relatively few germination tests in light and darkness have been made of the seed lots from Europe. At any rate, so little is known as to the exact details of collection, extraction and storage that any conclusions drawn from such tests may be incorrect. More is known in regard to collection, extraction and storage of the New York lots, but practically nothing is known as to the source of the seed producing the original trees. For any such study many factors may be considered. It has been shown above that time of collection may have considerable to do with the rate of germination or the degree of dormancy. Another factor might be the difference in individual trees. On September 20, 1937, collections were made from four trees growing in a group of the same age near the Saratoga nursery. The germination response of the seed of these collections is shown in Figure 4, and shows a wide variation in the individual trees. Tree #4, which germinated but 41% in 30 days in the daylight, germinated 99% in 5 days after being pre-chilled for

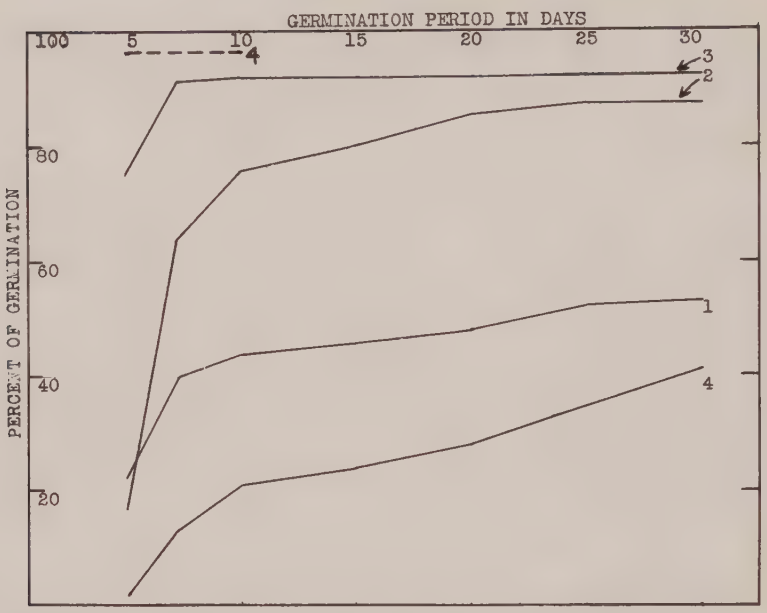

Figure 4. Germination trend of the seed of four trees of Scotch pine of the same age and on the same site. Tests made in Jacobsen germinator with a temperature of 25°C in diffused daylight. The low germination due to seed dormancy, since all had a germinative capacity of over 90%. Dotted line shown the germination of Tree 4 seed after being prechilled for 25 days.

25 days. Other collections made in Oneida County in 1935, 1938 and 1939 showed the same tendency of individual tree differences. Furthermore all the seeds from a single tree had the same color. The majority of seed collections of Scotch pine contain seeds of several different colors or shades. This is due to the different seed color characteristics of the individual trees which made up the collection. One exception has been noted, however, in the New York lots. The seed from the naturalized stands growing near Boonville have always been of a uniform black color, even though many collections have been made which were spread over a period of eleven years and collected from single trees and groups of trees. This uniform seed color suggested the idea that the original source might have been a single tree. This idea probably can never be proven in this particular case, but may be proven or disproven at some future date. In this connection a number of physiological tests used by European investigators in an attempt to distinguish races of Scotch pine, have been reviewed by Baldwin (2).

Regardless of the cause of dormancy in Scotch pine seed, its nature can be detected by the proper germination test. In any given lot to be sown, the nurseryman needs to know not only its viability, but also the nature of the seed as far as dormancy is concerned. From this information he can determine the amount of seed to sow and the best season for sowing. Seed which has little tendency to be dormant cannot be sown in the fall, since poor tree production will result because of pregermination. On the other hand, the most dormant seed, if sown in the fall, will germinate much better since if it is sown in the spring it will germinate slowly and many seed may remain ungerminated in the ground until the second year. Both the viability and the degree of dormancy can be determined by germination tests made in light and darkness. The best light source found was a continuous electric light at a temperature of 18°C. However, daylight is sufficient for all

except the very dormant seed, in which there may be some delay in germination.

The effect of light on dormant seed may apply to several other species of conifers, since Nelson (6) has recently found that the germination of the four southern pines, namely, longleaf, slash, loblolly and shortleaf, was delayed and reduced in darkness as compared with diffused sunlight.

Summary

1. Pregermination was found to occur in certain lots of Scotch pine seed when sown in the fall in the nursery.

2. Field and laboratory tests showed that the ability to pregerminate was due to the relative dormancy of the seed.

3. The least dormant seed pregerminated the greatest when sown in the fall, while the most dormant seed not only failed to pregerminate but gave better tree production when sown in the fall.

4. There was found to be a wide variation in the dormancy of the different lots of seed. In general, the seed received from Europe was less dormant than that collected from trees growing in New York state.

5. The later the seed was collected, the lesser the dormancy, yet this does not explain the remaining conditions surrounding dormancy which may be bound up with the factor of seed origin.

6. There was found to be a variation in state of dormancy of the seed of individual trees growing side by side. Each tree also produced seed of a characteristic color or shade.

7. Low temperature delayed germination almost equally in all lots. There is an indication that alternating temperatures help break dormancy, while too high temperatures may induce dormancy.

8. Light was found to be necessary to induce the germination of dormant seed. Such seed, when after-ripened through pre-chilling, germinated without light. Light supplanted the effect of after-ripening.

9. Germination tests made in light and darkness, before sowing in the nursery, will indicate the viability of the seed and the state to sow the seed for the maximum production of trees.

10. The optimum condition for laboratory germination of the most dormant seed lots was to provide continuous artificial light both day and night with a temperature of approximately 18°C. Germination was complete after 10 days under these conditions.

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Do We Need Flower Seed Germination Standards?

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By what standard or yardstick are we going to measure the viability results secured by germination tests of flower seeds upon the open market, is a question being asked more frequently than ever by those who either have a flower seed control law to enforce or are contemplating such a measure.

In New York State no germination standards are set up or provided for nor must containers be labeled to show the viability. However, the enforcing officer is empowered to remove from sale such seeds as are considered to be unfit because of low or weak germination. Just when does a stock of flower seed become "unfit" or "too low" in germination to be permissible on the market? When does it really become a practical commercial non-entity as flower seed? In other words, by what standards can one judge the planting usefullness of good commercial stocks of the various kinds of flower seeds? Early in the year an amendment was proposed to the present New York statute to require the labeling of all flower seeds containers to show the percentage of germination. This amendment, whether wise or unwise, failed of enactment.

In attempting to find an answer to these questions it was discovered thru questioning flower seed growers and professional seedsmen, that there appear to be two distinct sets of what seem to be working "standards" now in use. One of these sets of so-called standards is used by the packetor, who, after having made some guidance germination tests, decides whether or not to repacket or reblend the stock he has at hand. His standards seem very low or liberal. The other set of standards is in possession of the flower seed grower who claims that he can and does deliver to retailers and packeters seeds which are of good commercial viability. Now these two sets of so-called standards are quite wide apart for some kinds of flower seeds. The retailer, when questioned regarding the seemingly low viability of his stocks as purchased on the open market insists that they are the best he can get from the grower, while on the other hand, the grower affirms that he does not offer such low germinating stocks.

When vendors are questioned as to their offerings they almost invariably hasten to inquire what the standards for flower seeds really are, or what is expected. Some inquire in order to learn how low they can really go and still be passable, others want to know for their own information and edification, still others admit that they want to know so that they can blend up or down to the expected standards. A few professional seedsmen earnestly seek some useful commercial standards in order to conduct their business on an orderly basis.

If any seed control unit cares to do so and will purchase at random a reasonable number of representative kinds of flower seeds upon the open market they will

encounter many interesting experiences in trying to get some of them to germinate reasonably well, or tolerably well, or what term should one use to describe a working low limit or ceiling. Last year in New York a series of 321 samples of flower seeds were purchased as official samples. Of these 321 packets, 4 were absolutely worthless for seed, 16 were so low in germination as to be unfit for any practical cultural purposes, and 58 were really too low in germination (varied from 6 to 50%) to be regarded as acceptable commercial seed according to the opinion of flower seed specialists. In other words, 78 of these 321 flower seed offerings were not what they should be as regards viability. On the other hand there were fully 25 per cent of the stocks which germinated high and in accordance with the percentage figures which were supplied by flower seed growers as being their idea of suitable standards for commercial comparison purposes. There seems to be a great need for some reasonable and workable standards by which at least a large number of the common flower seed kinds can be compared. This work will require the cooperation of some of our best flower seed growers and seedsmen.

Separation of Immature Seeds of Trifolium repens - White Clover and Trifolium hybridum - Alsike Clover

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In Oregon the certification of Trifolium repens, especially Trifolium repens var. latum (Ladino clover), has created a number of acute problems for the analyst. The problem suggested here deals with the separation of immature seeds of Trifolium repens from those of immature Trifolium hybridum. Often samples of Ladino clover contain a small percentage of alsike clover and frequently this percentage consists of a number of immature seeds. Sometimes seeds of either species may be almost alike in appearance, making separation difficult. Further, since a part of the Oregon certification requirements for Blue Tag Ladino clover states that it may not contain more than 300 alsike clover seeds per pound, which would be less than 2 seeds in the 2-gram working sample, it is of utmost importance for the analyst to make an accurate separation of immature seeds when they are present. The separation of these immature or questionable seeds is a problem peculiar not only to seed certification but to any sample in which both species are found.

In 1939 two stocks were studied, one of T. hybridum containing a small percentage of T. repens, the other a T. repens containing some T. hybridum. From samples, the immature seeds which appeared indistinguishable were removed and were then separated by five different analysts into what they considered the two species. Characteristics used in dividing the seeds were the color tone, size, shape, and texture. These separations were then planted in sterilized soil in the greenhouse and the seedlings were allowed to grow to the flowering stage. The results are tabulated on the next page.

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[1]Seed Analyst.

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Seed Taken from Trifolium hybridum - Alsike Clover

Test* Number	Seeds Selected as White Clover			Seeds Selected as Alsike Clover		
	Number Planted	Plants Produced		Number Planted	Plants Produced	
		White	Alsike		White	Alsike
1	0	0	0	5	0	2
2	3	1	1	5	0	4
3	0	0	0	7	0	4
4	0	0	0	10	0	7
5	4	2	1	6	0	5
Total	7	3	2	33	0	22
Seed Taken from Trifolium repens - White Clover						
1	5	1	1	4	0	2
2	5	2	0	5	0	4
3	6	0	0	4	0	2
4	8	1	0	2	0	2
5	5	0	0	6	0	3
Total	29	4	1	21	0	13

*Separations were made by Katherine Schmidt, Peggy Hayes, Lucille Lindsay, Merle Weisner, and Louisa Ames Kanipe.

Although the table is based on a small number of seeds, it represents a large quantity as only the most questionable seeds were selected to be planted. All seeds selected as T. hybridum proved to be correctly identified, however, those considered to be T. repens suggested the lack of the same accuracy or dependableness and the need of further study of immature seeds.

In 1940 it was observed that the position and intensity of color might be usable factors for seeds not distinguishable by means of size, shape, or texture. Observations show that the degrees of yellowish color in T. hybridum tend toward a bluish green, while in T. repens the grades of yellow often appear more greenish yellow. The location of this color in T. hybridum is on the portion of the seed containing the cotyledons, near the micropyler end (See Fig. 1, B and D), while in T. repens the yellowish color is found on the portion of the seed containing the hypocotyl and radicle, spreading downward from the micropyler end to the opposite end of the seed (See Fig. 1, A and C).

These observations have been confirmed by examination of a number of samples of T. repens, known to be entirely free of T. hybridum and to three lots of T. hybridum known to contain no T. repens. Greenhouse tests are being conducted but are incomplete at this date.

This work should by no means be considered conclusive but the position and tone of coloration should be kept in mind as a possible basis for distinction.

ERRATUM

In the article, Application of Tolerances to Seed Analysis and Law Enforcement, Leggatt, C.W. Proc. Assoc. Off. Seed Analysts. 1939, page 98, the 13th and 12th lines from the bottom of the page and reading, "The same result may be obtained by reference to Przyborowski and Wilenski's (9) Table 5." should be deleted. This table is not strictly designed for the purpose suggested although, in general, it gives results very similar to those given by the formula.

NORMAL SEEDS

A

(A) Trifolium repens

B

(B) Trifolium hybridum

IMMATURE SEEDS

C

C

C

(C) Greenish seeds of T. repens with radicle area showing the yellow color tones.

D

D

D

(D) Greenish seeds of T. hybridum with the cotyledon area showing the yellow color tones.

Fig. 1. Seeds of Trifolium repens and Trifolium hybridum showing the relative position of the yellow color tones on immature seeds.

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